Rabena y3een 3ala el pdf da 😭🤡

GOOD LUCK 🥰

Question from 2018-2024

Made by: Nour Ahmed

1- Jan 24

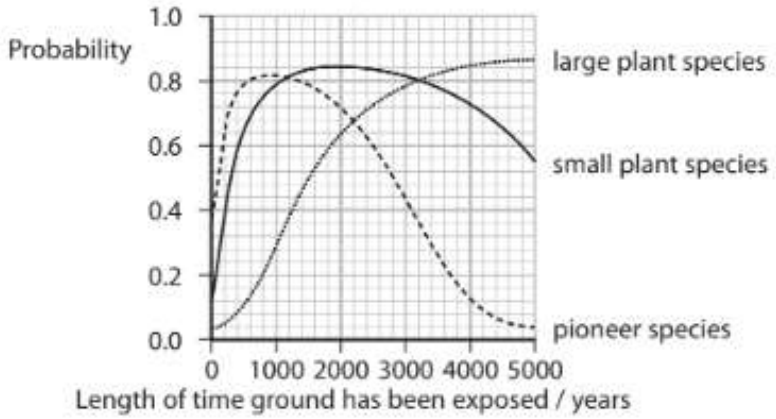
*(ii) The table shows the soil carbon : nitrogen ratio in ground exposed by a retreating glacier.

Length of time that the ground has been exposed / years	Carbon : nitrogen ratio in the soil
< 200	9.8
2000	11.6
3500	10.7
7200	10.3

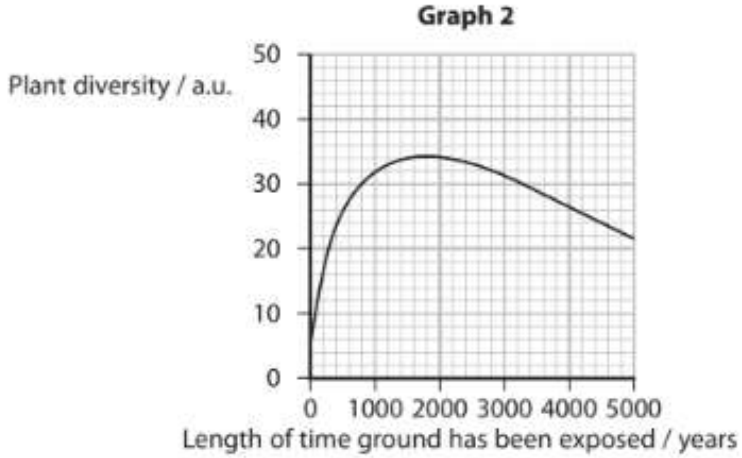
Graph 1 shows the probability that three different types of plant will be found on ground exposed for different lengths of time.

Graph 2 shows a model of plant diversity on ground exposed for different lengths of time.

Graph 1



Graph 2



U4 IMPORTANT QUESTIONS

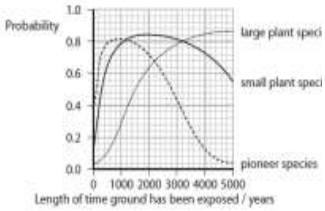
Explain the variations in soil conditions and the organisms found at different distances from the front edge of the glacier.

Use the information in the question and your own knowledge to support your answer.

Indicative content:

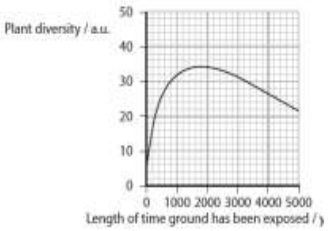
Graph 1 possible explanations :

- conditions and organisms vary with distance from glacier due to succession
- pioneer species arrive first because {conditions hostile / no soil / dry conditions}
- pioneer species die and improve the mineral / humus content in the soil
- these new conditions support small plants
- as small plants arrive, they compete with pioneer species for resources
- as small plants die they improve the soil mineral content / depth
- which will support larger plants
- which then compete with small plants for resources
- until a climax community is reached
- but this is not shown on the graph as the numbers are still changing



Graph 2 possible explanations :

- biodiversity is low when only pioneer species present
- increases as small plants arrive
- increases further as larger plants begin to arrive
- decreases as more larger plants grow
- as fewer plant species can be supported
- may decrease due to habitat loss



Carbon:nitrogen table possible explanations :

- ratio increases as more carbon added to soil / nitrogen is removed from the soil
- early increase corresponds with increase in pioneer species
- as dead plants decompose adding carbon / humus to the soil
- further increase as small plants arrive and die
- animals will be attracted to area with increase in plants species
- as plants provide food and shelter
- animal excrement and decomposing dead animals will add nitrogen to the soil
- decrease in ratio corresponds with increase in number of large plant species
- as more nitrogen because of leaf litter / nitrogen-fixing bacteria / nitrifying bacteria
- as less carbon due to more decomposition / respiration by decomposers

Length of time that the ground has been exposed / years	Carbon : nitrogen ratio in the soil
< 200	9.8
2000	11.6
3500	10.7
7200	10.3

Made by: Nour Ahmed

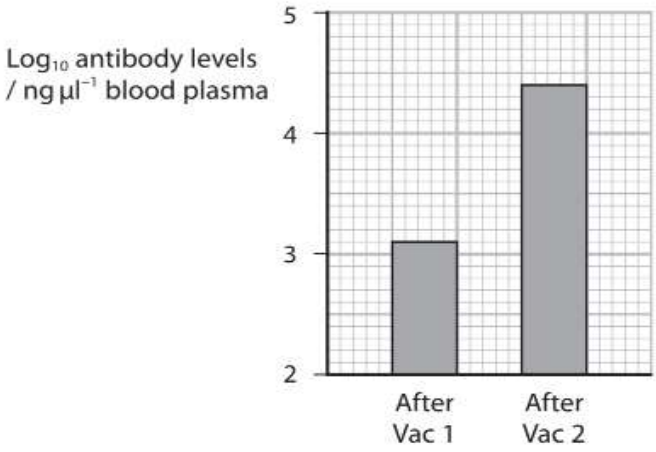
2-Jan 24

The levels of antibodies following vaccinations were investigated.

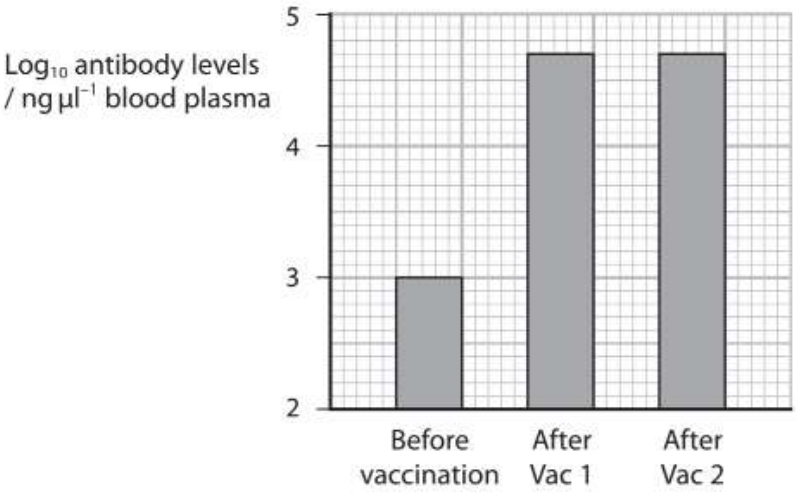
There were two groups of people. Group 1 **had not** been infected with the virus, before the vaccine was given. Group 2 **had** been infected with the virus before the vaccine was given.

Both groups of people received two vaccinations, Vac 1 and Vac 2.

The graphs show the results of this investigation.



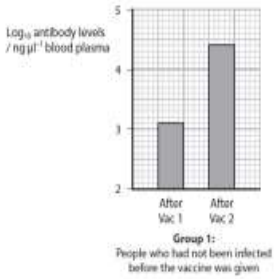
Group 1:
People who had not been infected before the vaccine was given



Group 2:
People who had been infected with the virus before the vaccine was given

Explain the results of this investigation.

Indicative content:



Group 1

Vac 1

- antibody levels increase following vac 1 because (primary) immune response initiated
- credit details of primary immune response
- resulting in plasma cells releasing antibodies

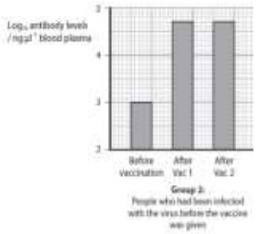
Vac 2

- vac 2 contains antigens that were in vac 1
- stimulate secondary immune response
- because memory cells present
- therefore results in higher levels of antibody released
- could be other antigens in vac 2 which stimulated production of other types of antibodies
- so both stimulated a primary immune response

Group 2

Before vaccination

- antibodies present as person previous infected so primary immune response generated



Vac 1

- vac 1 stimulated secondary immune response
- memory cells formed from infection
- so levels of antibodies produced were higher
- could have been other antigens present in vac 1
- contributing to higher levels of antibody

Vac 2

- vac 2 resulted in same levels of antibodies suggesting that antigens in vac 1 and vac 2 were the same
- but the time lapse between vaccination and testing was long enough for antibody levels to decrease
- vac 2 may have had different antigens to vac 1 but still stimulated secondary response

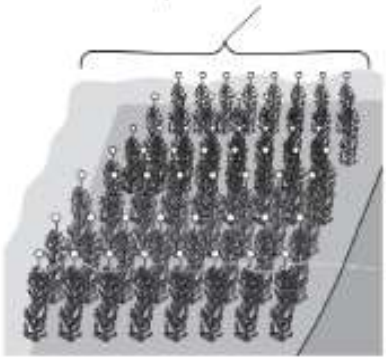
3-Nov 23

*(c) In Europe, cultivation of seaweed takes place on a small scale. Large-scale cultivation of seaweed is now being considered.

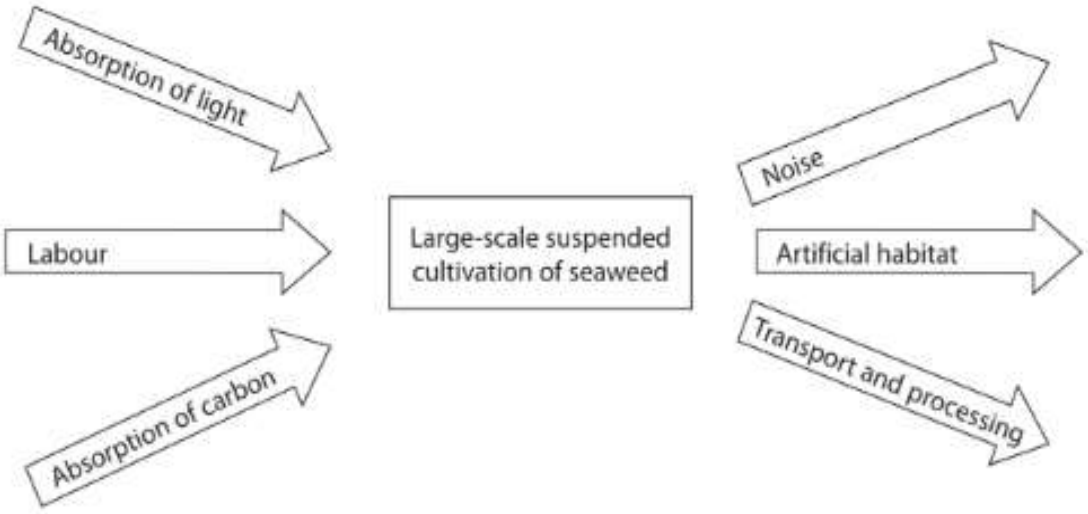
Effective management of the conflict between human needs and conservation is necessary before large-scale cultivation can be used.

The diagram shows seaweed grown by suspended cultivation, a method used in Asia.

Rows of seaweed suspended on wires in the sea



The diagram shows some of the factors that have to be considered when managing the conflict between human needs and conservation.



Discuss the considerations that need to be taken into account when deciding whether or not large-scale seaweed production is suitable in Europe.

Use the information in the two diagrams and your own knowledge to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
*5(c)	**Indicative content:** **Diagram 1:** • seaweed taking up space of other organisms • {fish / sea mammals} could get caught up in wires • could prevent {fishing / water sports / water activities / shipping} **Diagram 2:** • seaweed could reduce {food / habitat} of water animals • seaweed could compete with other (wild) aquatic plants for light • could provide labour for local population • increasing the economy of the area • increase in carbon dioxide removed from {atmosphere / water} / reduces greenhouse effect • machinery used to {grow / harvest} seaweed might disturb other organisms • causing them to {move away / be stressed} • interrupting food chain • presence of seaweed might provide {food source / habitat} for different species • which would compete with current species • interrupting food chain • increase biodiversity • machinery used to {transport /process} seaweed will burn fossil fuels **Other ideas:** • maybe other organisms brought into area on the seaweed • which would compete with other species for {food / habitat} • could bring in diseases • that could weaken or kill other species • will Europe have high enough {temperature / light levels} to sustain growth	**Level 1: Simple comments about aspects** 1 mark = one relevant comment 2 marks = simple comments relating to at least three aspects **Level 2: discussion about aspects linked to at least one diagram / idea** 3 marks = at least one aspect discussed in more detail 4 marks = at least two aspects discussed in more detail **Level 3: detailed discussion about aspects from both diagrams** 5 marks = at least three aspects discussed in more detail 6 marks = at least four aspects discussed in more detail which includes an idea not included in the diagram	**(6)**

4- Nov 23

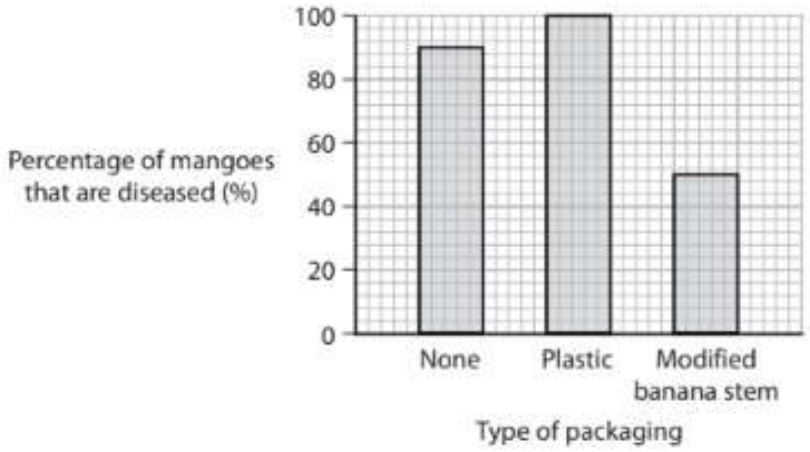
*(c) Mangoes are tropical fruits that are harvested before they are ripe.

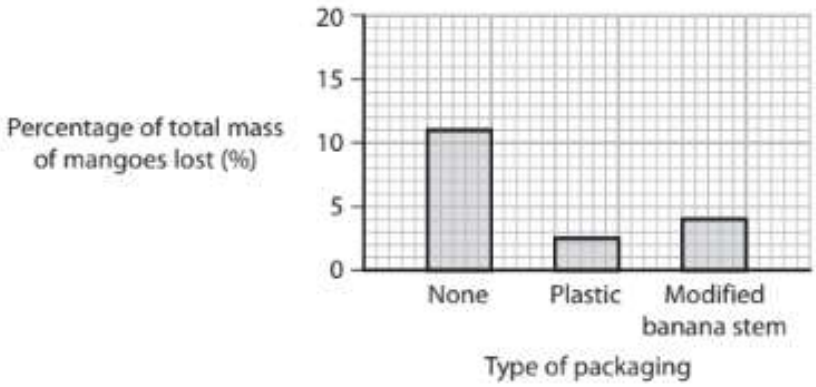
Plastic packaging is used to wrap mangoes after they have been picked. This preserves the fruit during transportation and storage.

Banana stalks have a high content of cellulose and have been modified to use as packaging material for mangoes.

A study compared the use of these two types of material and their decomposition.

The graphs and the table show the results of this study.





Time of decomposition of packaging / weeks	Appearance of packaging	
	Plastic packaging	Modified banana packaging
0		
2		
4		

Discuss the advantages of using packaging made from modified banana stalks.

Use the information in the graphs, the table and your own knowledge to support your answer.

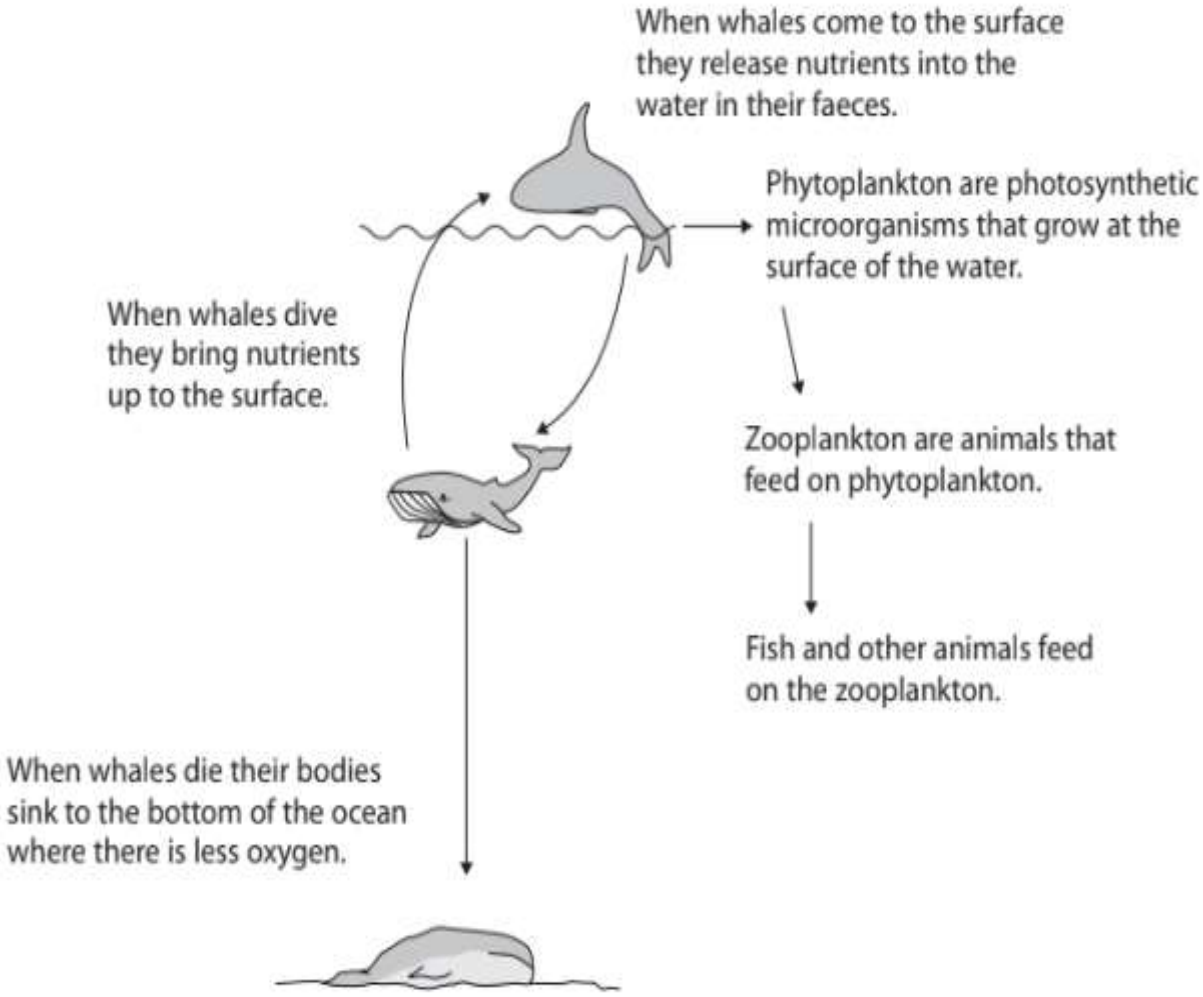
(6)

Question number	Answer	Additional guidance	Mark
*9(c)	**Graph 1:** • fewer mangoes are diseased (D) • so they will be more edible / less wastage • so more food to go round • increase profits of mango-producing countries **Graph 2:** • less mass is loss than no packaging / (slightly) more mass lost than plastic (D) • which is probably due to dehydration of the mango • therefore fruit will be more succulent • and add water to the diet • important in arid countries **Table:** • decomposes relatively quickly (D) • therefore biodegradable • will not be any plastics to go into the sea / land fill sites • so less damage to wild life • less interruption to food chain • contributes to carbon cycle **Other ideas:** • sustainable / carbon neutral • more banana plants grown reducing carbon dioxide levels • maybe less toxic • production of plastic results in burning of fossil fuels • plastics not always available to countries producing mangos • using plastic adds more to cost of mangos • plastics are expensive	**Level 1: simple** 1 mark = data in {one graph / table} described 2 marks = data in {both graphs / one graph and table} described **OR** one advantage described **Level 2:** advantages described 3 marks = one advantage discussed in detail **OR** two advantages described 4 marks = two advantages discussed in detail **OR** three advantages described **Level 3:** extended discussion 5 marks = three advantages discussed in detail **OR** four advantages described 6 marks = as for 5 marks but covers 3 sections	**(6)**

5- June 23

7 Commercial whaling has resulted in a large decrease in the number of whales.

The diagram shows the relationships between whales and some other organisms in the ocean.


When whales come to the surface they release nutrients into the water in their faeces.
Phytoplankton are photosynthetic microorganisms that grow at the surface of the water.
When whales dive they bring nutrients up to the surface.
Zooplankton are animals that feed on phytoplankton.
Fish and other animals feed on the zooplankton.
When whales die their bodies sink to the bottom of the ocean where there is less oxygen.

*(iii) Discuss the possible effects of increasing the number of whales on climate change.

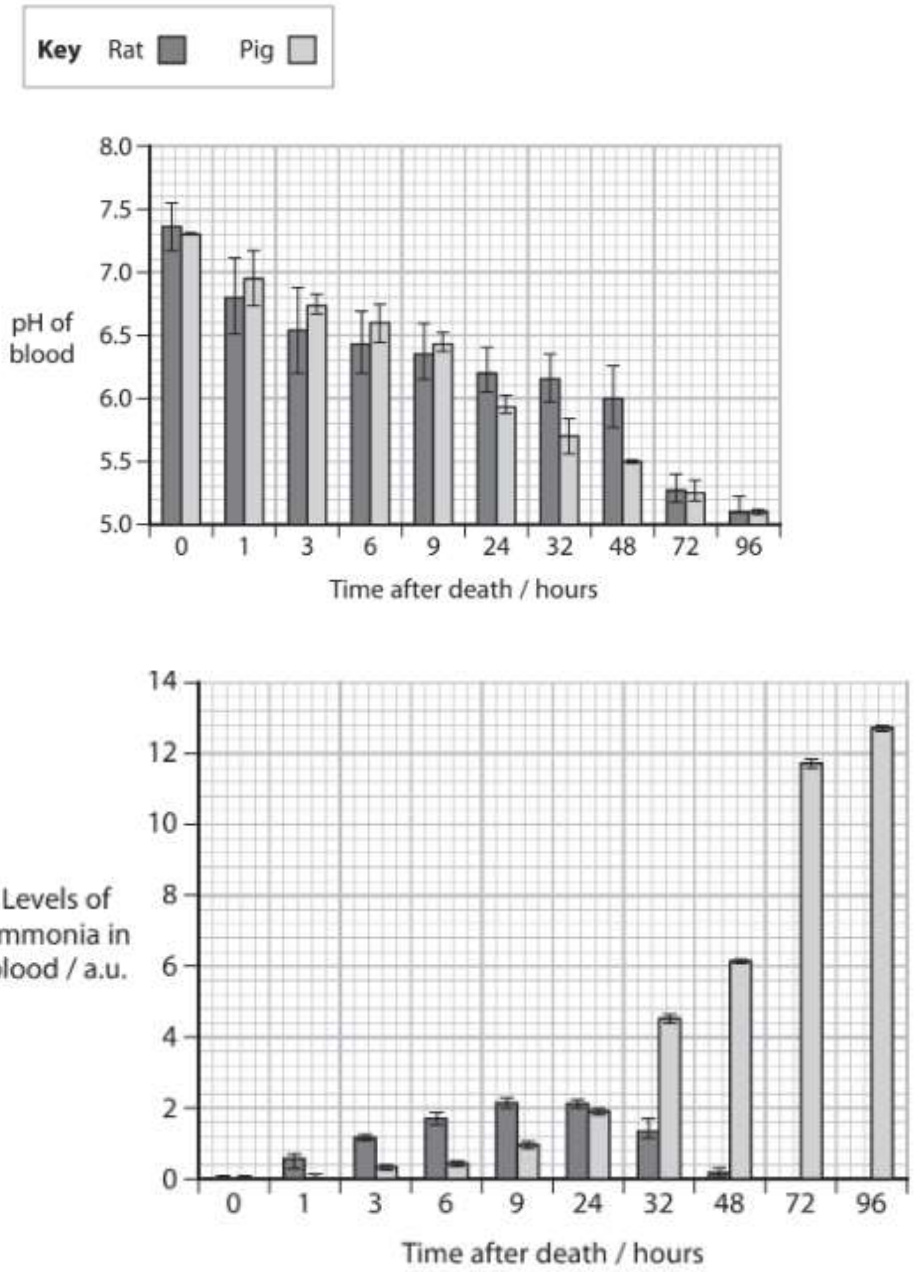
Use the information in the diagram and the data given in this question to support your answer.

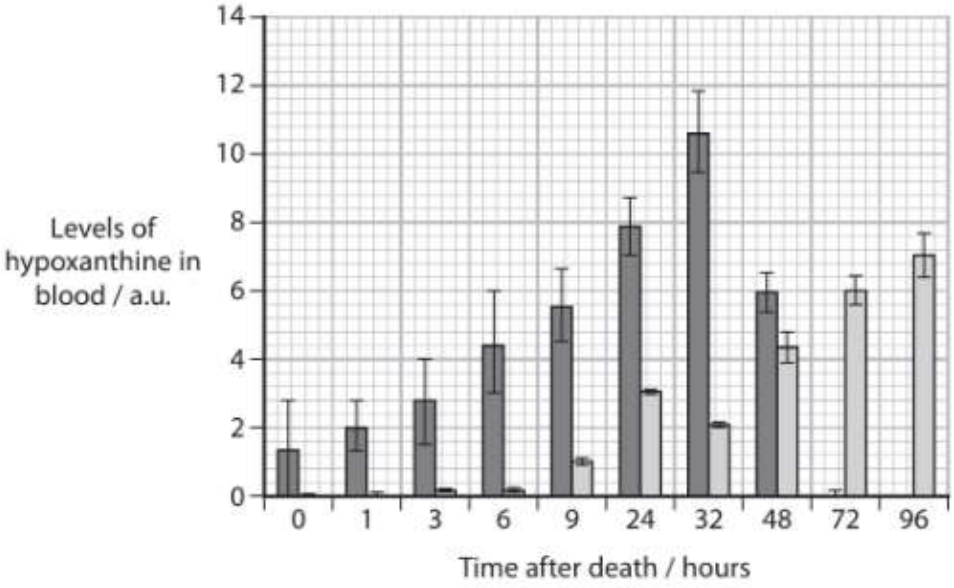
(6)

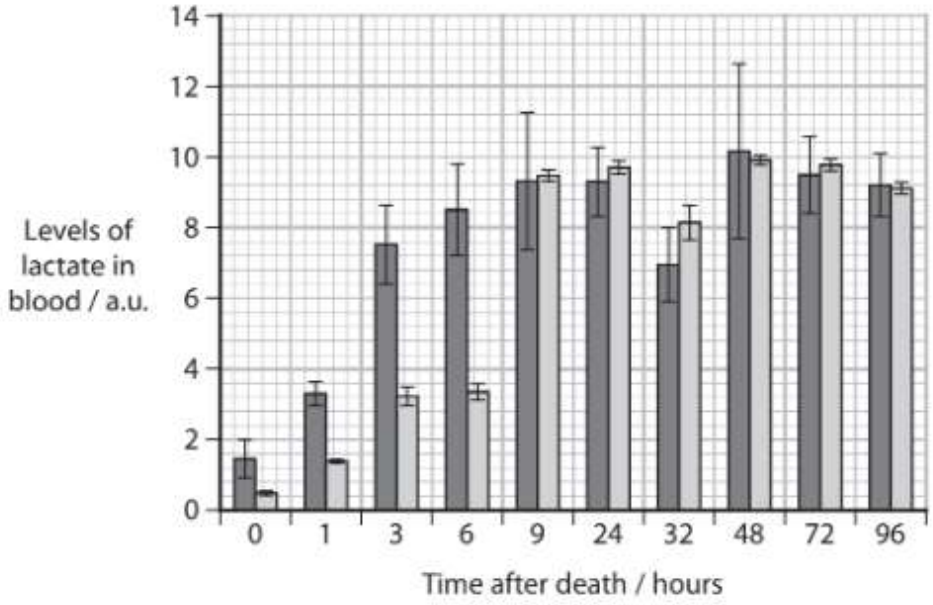
Question number	Answer	Mark
*7(b)(iii)	Indicative content: **Aspect 1 : Phytoplankton** • more phytoplankton results in more photosynthesis • absorbing more carbon dioxide from the air • therefore less greenhouse gases • so less infra red radiation trapped • reducing global warming • release of nutrients into oceans will increase number of phytoplankton • because they use the nitrate for growth and division **Aspect 2 : Animals other than whales** • so there will be more carbon dioxide released into the air • due to respiration • which would increase global warming • increase in phytoplankton will increase numbers of whales / other animals **Aspect 3 : Whales** • more whales more carbon dioxide from respiration • more whales more nitrates released • there would be a lot of carbon stored in the whale's body • as {carbohydrate / protein / fat} • whale acts as a carbon sink • dead {whales / organisms} decompose very slowly • as conditions unfavourable for {decomposers / decomposition} • therefore this carbon will not be released back into the atmosphere as carbon dioxide • helping to reduce global warming **Aspect 4 : Decomposition of phytoplankton and other animals** • increase in phytoplankton and other animals means more dead organisms • so more decomposition • releasing {methane / carbon dioxide} into the atmosphere • due to respiration by microorganisms • increasing global warming	(6)

6- June 23

*(ii) The graphs show some of the results of this study.




Levels of hypoxanthine in blood / a.u.
14
12
10
8
6
4
2
0
0
1
3
6
9
24
32
48
72
96
Time after death / hours


Levels of lactate in blood / a.u.
14
12
10
8
6
4
2
0
0
1
3
6
9
24
32
48
72
96
Time after death / hours

Comment on the usefulness of using these chemicals for determining the time of death of rats and pigs.

Use the information in the graphs to support your answer.

(6)

Question number	Answer	Mark
*9(b)(ii)		(6)

Chemical tests	Discussion of usefulness
pH	
Pigs	Useful because decrease with time Useful as there is an increase with time with {small error bars / very little overlap in error bars} so timings are quite accurate
Rats	Useful because decrease with time Useful as there is an increase with time but error bars overlap so would not give accurate timings
Ammonia	
Pigs	Useful as there is an increase with time Useful as there is an increase with time with no overlap in error bars so timings will be accurate
Rats	Not very useful as {no clear patterns / no trend / data goes up and down} Not very useful because data goes up and down so one value will give two times Not useful as no ammonia after 48 hours Useful for determining that there was more than 48 hours since time of death as no ammonia present
Hypoxanthine	
Pigs	Useful as there is an increase with time Useful as there is an increase with time with no overlap in error bars so timings will be accurate Very low levels between 0 and 6 hours with overlapping error bars so may not be useful {then / until after 6 hours} There is an anomaly (at 24 hours) so this would need further investigation to see if this affects accuracy
Rats	Not very useful as {no clear patterns / no trend / data goes up and down} Only useful up to {9 hours /32 hours} Only useful up 6 hours otherwise one level could give two different timings
Lactate	
Pigs	Not very useful as {no clear patterns / no trend / data goes up and down} Could be useful up to 9 / 24 hours as there is an increase in levels / not useful after 9 /24 hours as levels fluctuate
Rats	Not very useful as {no clear patterns / no trend / data goes up and down} Could be useful up to 9 hours as there is an increase in levels / not useful after 9 hours as levels fluctuate
General	small sample size so questionable significance use more than one marker and combine results results indicate that the test are species specific overall pigs are more useful than rats

7- Jan 23

*(b) It has been estimated that because humans have planted more trees and crops, the leaf area increased by 0.5 million km^2 between 2019 and 2000.

China accounts for 25% of this increase. It planted forests and crops, in equal proportions.

India accounts for 7% of this increase. It planted mostly crops.

Discuss the possible impacts of planting forests or crops on global warming, biodiversity and the local population.

(6)

Question number	Answer	Mark
*5(b)	**1 Aspect : Positive impact on local (human) population:** • crops will provide food • forests will provide materials for {building / making fires} • {crops / forest} will provide {employment / income} • {crops / forests} encourage new animals that might provide food • credit effect of reduced global warming on people e.g. no extremes of temperature, no droughts **2 Aspect : Negative impact on local (human) population:** • {crops / forests} may replace the crops they were growing already • {crops / forests} may {reduce / replace} the land they were using for animals • {crops / forests} may {reduce / replace} the land they were {living on / using for houses / factories} • crops use {pesticides / fertilisers} which is expensive for farmers **3 Aspect : Positive impact on global warming:** • carbon dioxide will be removed from the atmosphere • decreasing the greenhouse effect • extremes of temperature should be reduced • extremes of precipitation should be reduced **4 Aspect : Negative impact on global warming:** • planting crops may reduce carbon dioxide levels less than {forests / pre-existing crops} • machinery used in {planting {forests / crops} / harvesting crops} produces carbon dioxide • burning {plants / trees} produces carbon dioxide **5 Aspect : Positive impacts on biodiversity:** • planting {crops / forests} may increase (new) habitat • plants may provide food • increase in herbivores may increase carnivores **6 Aspect : Negative impacts on biodiversity:** • planting {crops / forest} could reduce (original) habitat • crops are monocultures and therefore reduce biodiversity • trees planted may not be suitable species • crops use pesticides that could harm food chains	(6)

8-Nov 22

*(b) Discuss the effects that forest fires have on the local atmosphere and local biodiversity, in the short term and the long term.

(6)

Question number	Answer	Mark
*8(b)	**Local atmosphere:** • increase in CO_2 levels in the atmosphere • increase global warming • increase in soot / smoke • when the organic matter is burnt • soot prevents so much light penetrating • details of global warming • extent depends on {size / frequency} of fires • less CO_2 being removed from the atmosphere • as there are fewer trees to photosynthesise • CO_2 levels in atmosphere will begin to drop • as CO_2 diffuses away from the area • new plants will begin to grow • growing plants will be photosynthesising faster (than established plants) • therefore will be absorbing CO_2 from the atmosphere **Local biodiversity:** • biodiversity will decrease • because plants and animals are killed • because plant and animal homes will be destroyed • animals depend on plants • effect on food chains • fragmentation of habitat • fewer organisms of a species could affect gene pool • increase in inbreeding further decreasing biodiversity • plants will begin to sprout • seeds will germinate • (secondary) succession begins • increasing biodiversity • as biodiversity of plants increases so does the biodiversity of animals • eventually climax community re-established	(6)

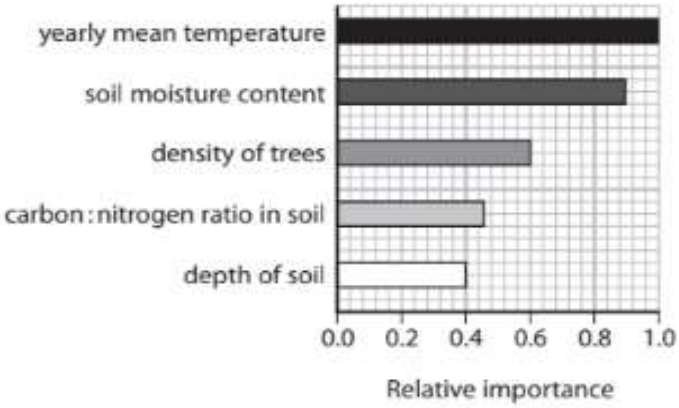
9-Nov 22

*(d) Forests, shrublands and grasslands are three types of ecosystem.

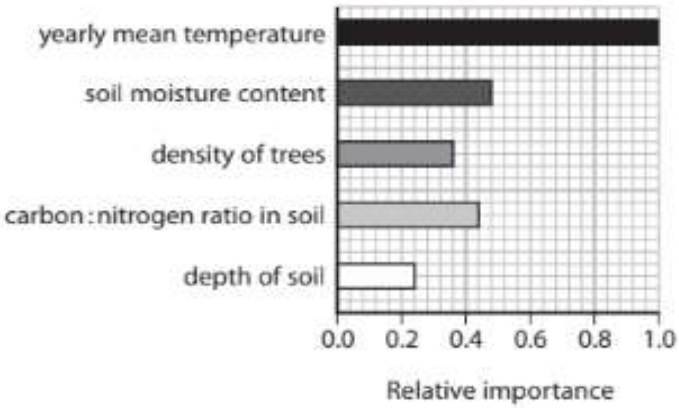
Biotic and abiotic factors affect how much biomass is stored in the roots of plants.

The graphs show the importance of some abiotic factors in determining how much biomass is stored in the roots in these ecosystems.

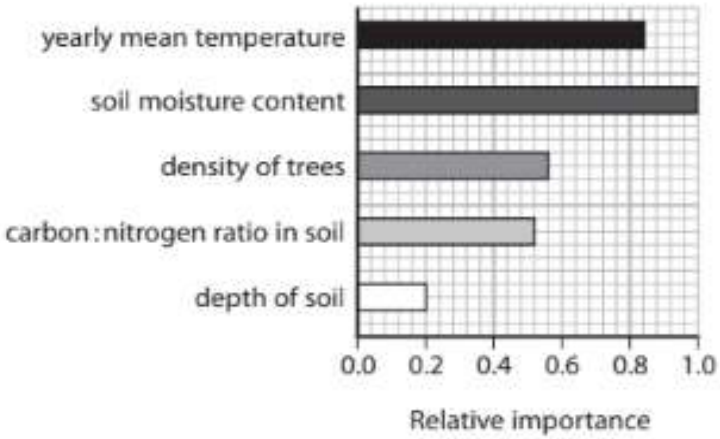
Forests



Shrublands



Grasslands



Discuss how these factors could affect the proportion of biomass stored in the roots of plants growing in these three ecosystems.

(6)

Question	Answer	Mark
*9(d)	**Yearly mean temperature:** • (overall) has the greatest influence /has the greatest influence in forests and shrublands • because temperature affects enzyme activity • details of effects • in plants of all three ecosystems • therefore faster photosynthesis and production of glucose • RUBISCO works faster increasing light-independent reactions • and production of GALP **Soil moisture content:** • has the greatest influence in grasslands / second greatest influence (overall) • because water needed for photolysis / light-dependent reactions • without which photosynthesis will not occur and GALP will not be made • water needed for transpiration and transport of mineral ions • water needed to transport sucrose / amino acids to roots • water maybe more important to trees / grass as they have extensive root systems **Density of trees:** • influential in all ecosystems • high density of trees will cause {competition for light / shading} • so rate of light-dependent reactions will be slower • so less ATP for light-independent reactions • so less biomass available in the roots **Carbon : nitrogen ratio:** • affects all three types of plant to some extent but low importance • plants need soil nitrates for amino acid production • less nitrogen less protein available • protein examples e.g. enzymes, RUBISCO • for active transport of mineral ions **Depth of soil:** • affects trees the most but least importance • soil needed for anchorage / water / mineral ions • because they need deeper soil and more extensive root system • therefore more biomass needed in their roots • shrubs / grass can grow in shallow soil as root system less extensive	**(6)**

10-June 22

*(b) The photographs show gerenuk and a springbok to the same magnification.

gerenuk

(Source: © David Havel / Alamy Stock Photo)

springbok

The table gives some information about gerenuk and springbok.

Information	Gerenuk	Springbok
Diet	leaves from a range of different trees, often spiny trees, up to 2 m from the ground	short grass and bushes
Water requirements	met by water content of food	will drink water when available
Height / cm	80 to 105	69 to 87
Mass / kg	male 45 female 30	male 41 female 37
Colour of fur	light brown with a white underbelly	light to mid brown with large areas of white
Length of horns / cm	25 to 44 in males only	35 to 49 in both males and females but narrower horns in females

Gerenuk and springbok evolved from a common ancestor.

Deduce how the gerenuk evolved to occupy a different niche from a springbok.

Use the information in the table and the photographs to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
*5(b)	Level 1 points: • due to natural selection (Descriptions of differences in features) • gerenuk's food is higher up / springbok's food is lower down • gerenuks have longer {necks / limbs} • gerenuk's white areas are {underneath / more concealed} • better adapted organisms survive and reproduce • passing their alleles onto their offspring Level 2 points: • occupy a different niche because they eat different food (Descriptions of how mutation caused a difference) • change in length of {neck / limbs} due to a mutation • change in type of horns due to a mutation (Explanations of how a features are an adaptation / result in difference in behaviour) • organisms with longer neck could reach the higher leaves • organisms with smaller horns did not get caught up in branches • smaller organisms had to go to waterhole for water • organisms with larger horns could defend off predators • male gerenuks kept horns for fighting for females • reference to {reduced gene flow / change in allele frequency / reproductive isolation} with no links made Level 3 points: • length of {neck / limbs} is a polygenic characteristic • type of horns is a polygenic characteristic • therefore organisms will show (continuous) variation for this phenotype • height of food acted as a selection pressure on size • {branches / predators} acted as a selection pressure on horns • organisms that {occupy a different niche / feed on different food} are not in competition with each other • two groups of organisms moved apart depending on where their food was • sympatric speciation / organisms not separated by a physical barrier • therefore reduced gene flow (between the two groups) • resulting in changes in the allele frequency • eventually resulting in reproductively isolated • and the formation of two species	**Level 1:** 1 mark = 1 point made from any level 2 marks = 3 points made from any level **Level 2:** NB Must be a reference to the data / context of the question 3 marks = 4 points made which include at least one level 2 point 4 marks = 5 points made which include at least one level 2 point **Level 3:** NB Horns and {leg / neck} length must be included 5 marks = 6 points made which includes at least one level 3 point 6 marks = 7 points made which includes at least one level 3 point	(6)

11-June 22

(b) Tasmanian devils feed on the dead bodies of animals (carcasses) and scare off other scavengers.

Scientists have studied the scavenging of carcasses in two regions of Tasmania: one region where all Tasmanian devils were healthy and one region where the cancer was common.

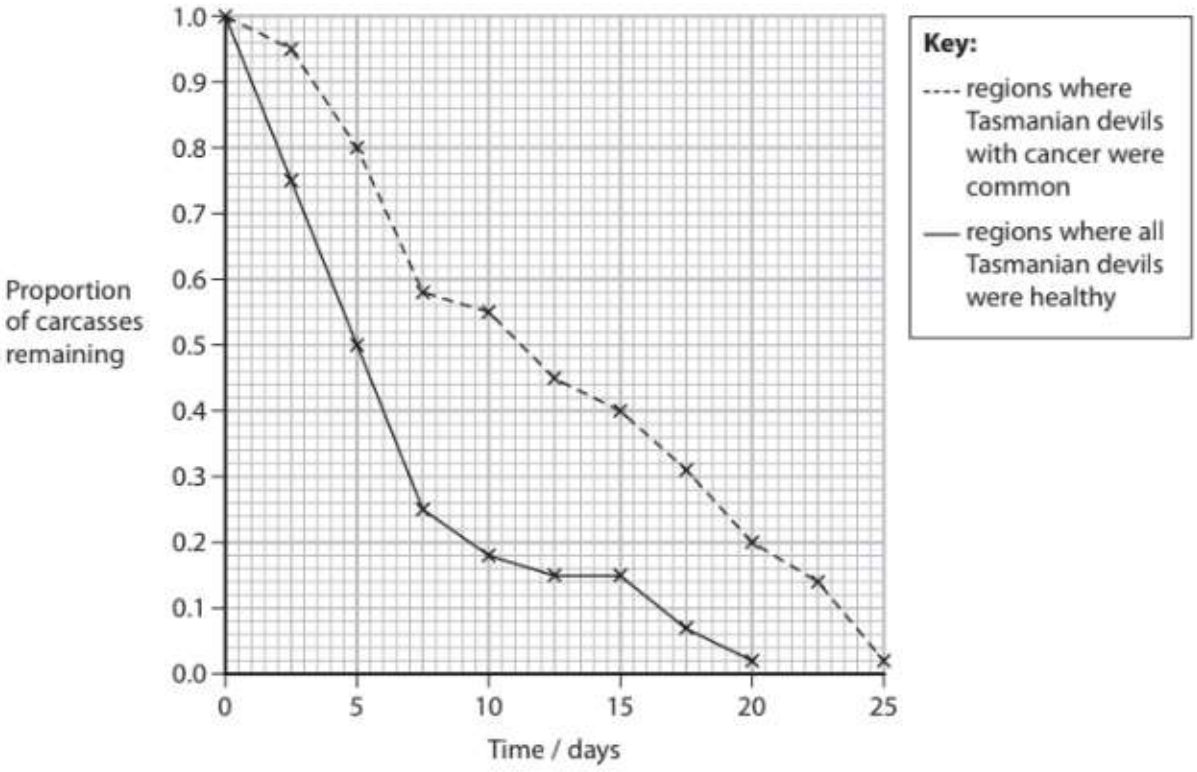
The length of time Tasmanian devils and three other scavenging animals spent feeding on carcasses was investigated.

The results are shown in the table.

Region	Proportion of time the scavengers spent feeding on each carcass			
	Tasmanian devil	Forest raven	Spotted-tailed quoll	Feral cat
Where all Tasmanian devils were healthy	0.76	0.13	0.06	0.05
Where Tasmanian devils with cancer were common	0.26	0.38	0.20	0.16

The length of time it took for the carcasses to be completely eaten was also investigated.

The results are shown in the graph.



*(i) Explain the results of these two studies.

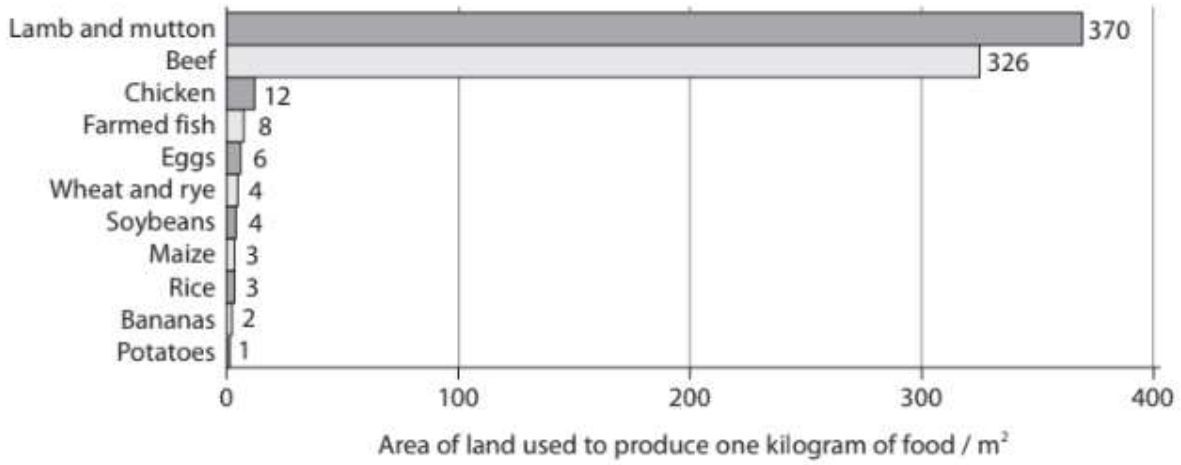
Use the information in the table and the graph to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
*7(b)(i)	**Table:** • Tasmanian devils spend less time feeding in cancer areas (D) • because there are fewer Tasmanian devils in these areas (E) • because they have died from the cancer (E) • because they are sick and get chased away by the other scavengers (E) • because they are sick and have lost their appetite (E) • {ravens / quolls / cats} all spend longer feeding in cancer areas (D) • because there are fewer Tasmanian devils (E) • therefore more food to go round / less competition (E) • because there are fewer Tasmanian devils to frighten them away (E) • because sick Tasmanian devils are too ill to chase scavengers away (E) • ravens, quolls and feral cats in similar proportions in both areas (D) • because they eat different parts of the carcass (E) • so are not in competition with each other (E) **Graph:** • carcasses in cancer areas are lasting longer than those in the healthy area (D) • because there are fewer Tasmanian devils to feed on the carcass (E) • because they are sick and have lost their appetite (E) • because scavengers do not eat as fast as Tasmanian devils (E) • because scavengers do not eat all the carcasses (E) • but they eventually breakdown by {decomposers / other scavengers} (E)	**ACCEPT** converse throughout where appropriate **Level 1:** 1 mark = one description only 2 marks = two descriptions **OR** one simple explanation **Level 2:** 3 marks = more than one explanation from either table or graph 4 marks = explanations for both table and graph **Level 3:** 5 marks = explanations for both table and graph, one of which is extended 6 marks = to include extended explanations for both table and graph **NB** Extended explanation either offers two alternative explanations or has two steps to it	**(6)**

12-Jan 22

*(c) The diagram shows the area of land used to produce one kilogram of some food products.



Explain how food production could be made more sustainable.

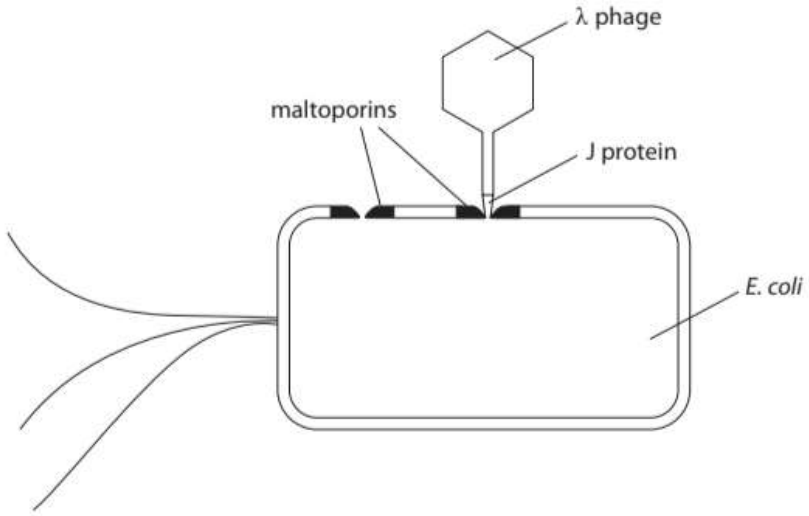
Use the information in the diagram and your own knowledge to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
*7(c)	• recycling of plant material (D) • to add nutrients to ground • so that artificial fertiliser use is reduced • which will cause less harm to the environment • genetic engineering to produce more {insect / drought} resistant crops (D) • to grow higher yield crops • so that more food is produced from the land • and fewer habitats have to be destroyed • reduce air miles to transport food (D) • use biofuels to fuel machinery used in farming (D) • use waste crop materials to make biofuels (D) • so that less carbon dioxide is released into the air • raise fewer animals and grow more crops (D) • because animals release carbon dioxide into atmosphere • which contribute to greenhouse effect • plants absorb more carbon dioxide from atmosphere • use solar / wind power for energy need in farming (D) • as these are sustainable • and do not produce carbon dioxide • encourage population to eat more plant-based foods (D) • as more mass of food can be produced from the land • because fewer trophic levels therefore less energy lost from the food chain • credit examples given from the diagram • reduce the quantity of plastic in packaging of food (D) • because it is not biodegradable • because it can harm animals	**Level 1:** 1 mark = one aspect described 2 marks = one aspect described with a simple explanation **Level 2:** 3 marks = one aspect described with an extended explanation OR two aspects described each with a simple explanation 4 marks = two aspects described each with an extended explanation OR three aspects described each with a simple explanation **Level 3:** 5 marks = three aspects described, all with extended explanation 6 marks = three aspects described, all with extended explanation that includes energy loss from a food chain	**(6)**

13-Jan 22

The diagram shows the pathogen lambda phage (λ phage) attached to its host cell, *E. coli*.



*(ii) Discuss how *E. coli* and λ phage could interact and develop in their evolutionary race for existence.

Use all the information in this question to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	**Points relating to the bacterial cell:** • mutation in the {lamß gene / gene coding for maltoprotein} • changing the structure of the maltoprotein • so that the J protein can no longer {bind / bind as well} • mutation resulting in the production of a (new) enzyme • that can cleave the J protein off the maltoprotein • preventing E. coli from being {infected / destroyed} • bacteria that survive will divide (asexually) • forming a clone of resistant bacteria • presence of virus acting as a selection pressure • but the maltoprotein would need to remain functional • otherwise no sugars for respiration **Points relating to the λ phage:** • without being able to attach to the bacteria, the virus will not persist • as it needs a host cell to replicate • being able to bind is the selection pressure • mutation in the viral DNA coding for the J protein • that would result in a J protein capable of binding to the altered maltoprotein • that would result in a J protein that could bind more strongly to the maltoprotein • that would result in binding to another attachment site • viruses that can bind will result in production of viruses that can also bind • as their genetic material will be cloned inside the host cell	**Level 1:** **1 mark** = 1 relevant comment made **2 marks** = 3 points made **Level 2:** **3 marks** = 4 points made that include both virus and bacteria **4 marks** = 5 points made that include both virus and bacteria **Level 3:** **5 marks** = 6 points made that include both virus and bacteria **6 marks** = 6 points which include **Either** the need for the maltoprotein to remain functional **Or** how mutations are passed on to next generation of viruses and bacteria **NB** limited to max 3 marks if no reference made to either J protein or maltoproteins	**(6)**

14-Nov 21

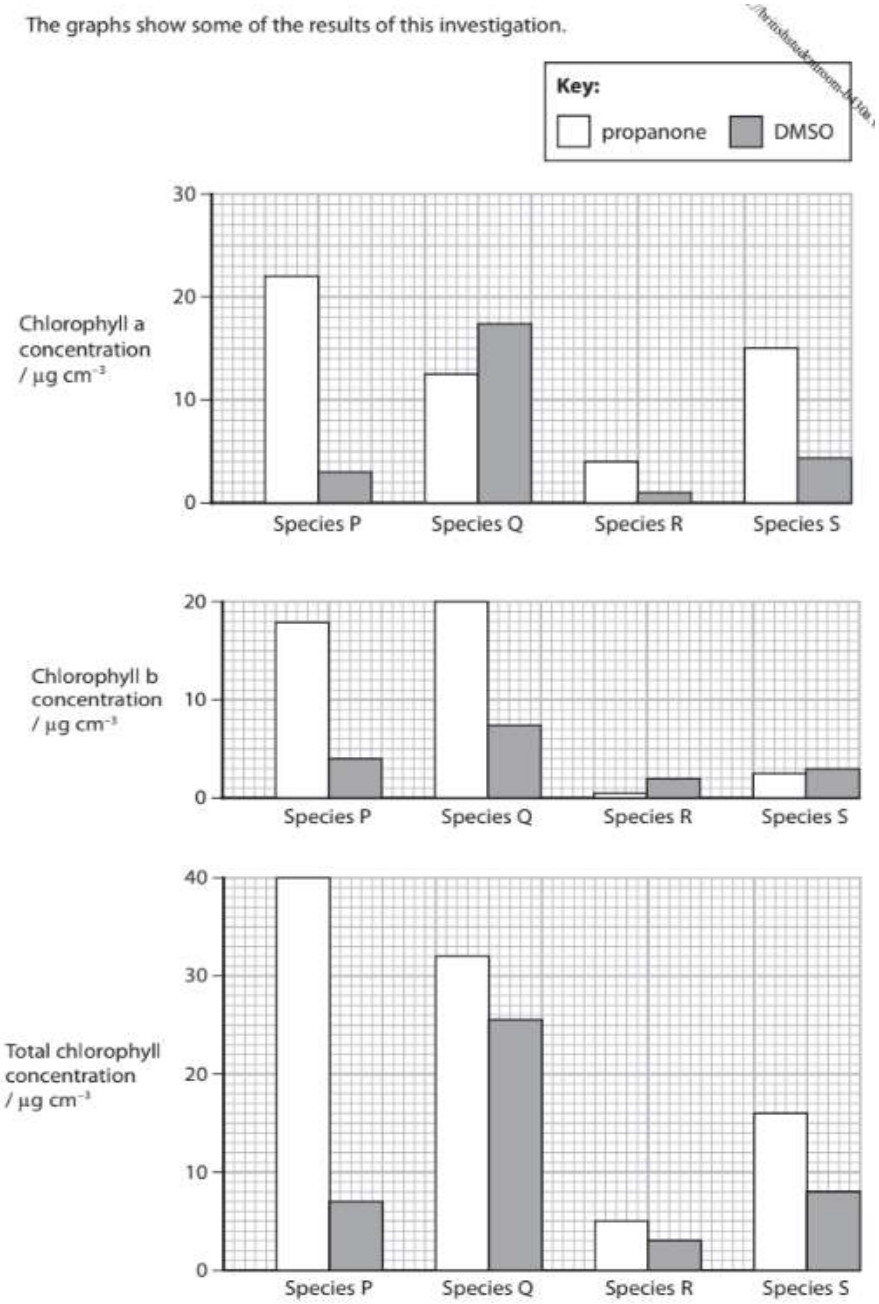
(c) An investigation compared the effectiveness of two solvents, propanone and DMSO, in extracting photosynthetic pigments.

Four species of seaweed were collected from the Indian coast of Tamil Nadu and taken to the laboratory where the species were identified.

Each species of seaweed was split into two samples of equal mass.

The photosynthetic pigments were extracted from each sample using one of the two solvents and their concentrations determined.

The graphs show some of the results of this investigation.



*(i) Discuss the effectiveness of these extraction methods in the identification of these species.

Use the information in the graphs to support your answer.

(6)

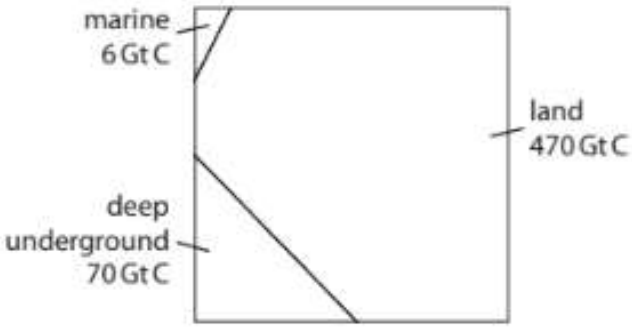
Question number	Answer	
*6(c)(i)	Indicative content: Comparisons: • propanone extracts more chlorophyll a from species P • propanone extracts more chlorophyll a from species R • DMSO extracts more chlorophyll a from species Q than propanone • propanone and DMSO extract similar concentrations of chlorophyll b from species S • propanone extracts more chlorophyll b from species P • propanone extracts more chlorophyll b from species Q • propanone extracts more total chlorophyll from species P Generalisations: • propanone is the most effective solvent at extracting chlorophyll • species P appears to contain the most chlorophyll when using propanone • DMSO is generally less effective than propanone except when extracting chlorophyll a from species Q **Implications in identifying species:** • some chlorophyll lost when extracted together as total is less than the sum of the components • other pigments extracted in some cases as total is more than individual components added together • the choice of solvent depends on the chlorophyll / species being extracted • because of difference in solubility (of pigments / membranes) / permeability of membranes • more than one solvent needs to be used if this method is to be used for identifying species • as different solvents extract different concentrations of different chlorophylls from different species • possibility of looking at extraction of other pigments • some sort of comparison table / calibration curve needed to match profile to extraction profiles • propanone better if only using one solvent as results the most varied • avoids need for DNA analysis • comparisons can be made in the field / with simple equipment • no indication of validity of data	**Level 1 :** 1 mark = 2 comparisons listed 2 marks = 4 comparisons listed **Level 2 :** 3 marks = 6 comparisons OR 1 generalisation + 3 comparisons OR 2 generalisations 4 marks = one implication discussed **Level 3 :** 5 marks = two implications discussed 6 marks = three implications discussed

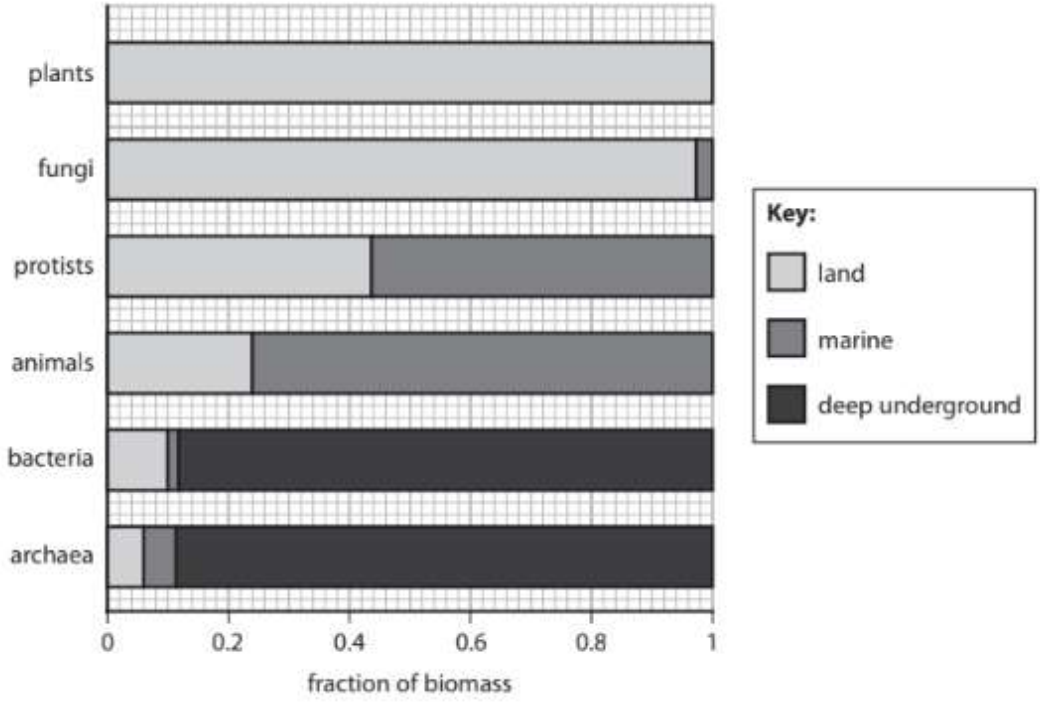
15-Nov 21

*(c) The same study also determined the distribution of biomass in three different environments: marine, deep underground and land.

The Voronoi diagram shows the distribution of biomass in each environment.

The graph shows the proportion of biomass in different groups of organisms.





Explain the distribution of biomass in these three environments.

Use the information in the Voronoi diagram and the graph to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
*8(c)	**Indicative content:** **Voronoi diagram:** • most biomass found on land and least found in marine (D) • because land provides the most suitable conditions to sustain living organisms* • such as light (for plants and algae) / water **Plants:** • all plants found on land (D) • because need enough light for photosynthesis • not in marine (D) • as salt water not suitable • not found deep underground (D) • as no light for photosynthesis **Fungi:** • predominantly found on land (D) • because they need a solid place to feed • because they need (gaseous) oxygen for respiration • not found deep underground (D) • because barely any other organisms live there to provide organic matter to decompose **Protists:** • found on both land and in marine environment (D) • because enough light for those that photosynthesise • they are the producers for the marine food chains* • can feed on {phytoplankton / algae} in the sea • not found deep underground (D) • because no light for those that photosynthesise • because no food **Animals:** • found on land and in a marine environment (D) • because have adapted for {feeding / movement} in both of these environment • can feed on {plants / seaweeds / other animals} • not found deep underground (D) • because no {food / water / pressure too high / ground too hard}	**Level 1 :** 1 mark = 2 descriptions 2 marks = 4 descriptions **OR** 1 {organism / Voronoi diagram} explained **Level 2 :** 3 marks = 2 {organisms / Voronoi diagram} explained 4 marks = 3 {organisms / Voronoi diagram} explained **Level 3 :** 5 marks = 4 {organisms / Voronoi diagram} explained 6 marks = 4 organisms explained **AND** explanation of Voronoi diagram* **OR** realises that there must be a non-plant producer in the sea*	(6)

	Bacteria: • one of two groups to be found in all three environments (D) • because can obtain energy from decomposition on the {land / marine} • can use alternative sources of energy deep underground **Archaea:** • one of two groups to be found in all three environments (D) • because can obtain energy from decomposition on the {land / marine} • can use alternative sources of energy deep underground		

16-June 21

7 Stages of succession can be seen on different parts of a sand dune system.

The greater the distance of the sand dune from the sea, the later the stage of succession.

The diagram shows a sand dune system and the table gives some information about the different types of sand dune in this system.

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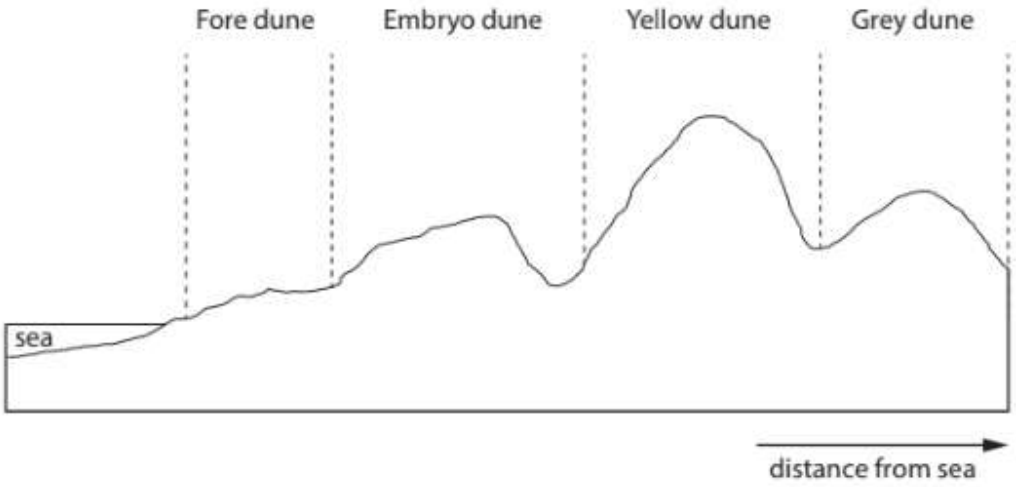

Information	Fore dune	Embryo dune	Yellow dune	Grey dune
Soil depth / cm	<0.5	0.5	1.0	8.0
Percentage of organic matter (%)	<1.0	1.0	2.5	5.0
pH	8.5	8.0	7.0	6.5
Percentage of bare ground (%)	>97	97	70	10
Number of different plant species	2	3	6	15
Typical plant species	sea rocket saltwort	sea couch grass lyme grass marram grass	marram grass red fescue grass sea holly	range of different meadow plants

*(iii) Explain the changes in these sand dunes with distance from the sea.

Use the information in the table to support your answer.

(6)

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Question number	Answer	Additional guidance	Mark
*7(a)(iii)	Indicative content: • soil depth increases with distance from the sea (D) • because these are older sand dunes (E) • so more time for humus to build up (E) • organic material increases with distance from the sea (D) • because these are older sand dunes • so more decomposition adds organic material to the sand (E) • due to activity of microorganisms (E) • pH falls with distance from the sea (D) • because more humus is added to the sand (E) • more rain (over the years) washes out minerals (E) • percentage of bare rock decreases with distance from sea (D) • because pioneer species break it down (E) • because as more soil is produced, it covers the bare rock (E) • number of different species of plant increase with distance from sea (D) • because the soil {is becoming more fertile / salinity is decreasing} (E) • organic material holds more moisture than sand alone (E) • types of plant change with distance from sea (D) • as soil becomes more favourable for more plant species (E) • more plants improve soil conditions further (E)	Level 1 : 1 mark = 1 description of {data / succession} 2 marks = 3 descriptions {of data / succession} OR 1 description of data + an explanation Level 2 : 3 marks = 2 descriptions of the data and an explanation of both 4 marks = 3 descriptions of the data and all three explained Level 3 : 5 marks = 4 descriptions of the data and all 4 explained 6 marks = 5 descriptions of the data and all five explained	(6)

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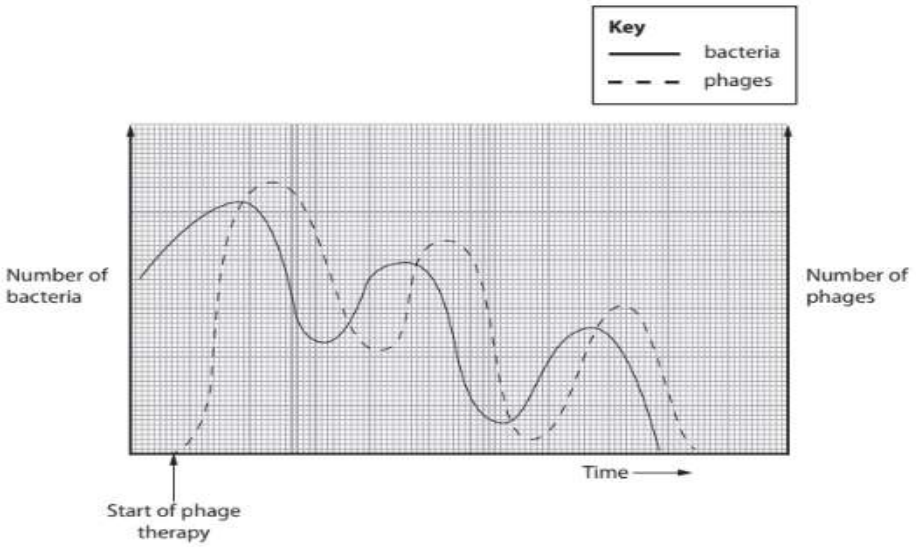
17-June 21

*(b) Phage therapy was used to treat the *Mycobacterium* infection in this patient.

Phages are viruses that target bacterial cells.

The graph shows how the number of *Mycobacterium* and the number of phages changed following the start of phage therapy.



Explain the changes in the number of bacteria and phages following the start of the phage therapy.

Use the information in the graph to support your answer.

Question number	Answer	Additional guidance	Mark
*8(b)	**Indicative content:** • number of bacteria still increasing at start of phage therapy (D) • because it takes time for lytic cycle (E) • bacteria number decrease (D) • because cells get destroyed when viruses burst out (E) • due to lytic cycle (E) • virus numbers increase (D) • because viruses replicate inside bacteria (E) • and burst out (E) • virus numbers increase after bacterial numbers increase (D) • because it takes time for synthesis of new components (E) • virus particles decrease (D) • because they get {engulfed / destroyed} by macrophages (E) • cyclical increase and decrease in the number of bacteria (D) • because not all bacteria get infected (E) • therefore surviving bacteria reproduce and increase in number (E) • cyclical increase and decrease in number of viruses (D) • because macrophages cannot destroy all viruses (E) • because viruses infect more bacteria (E) • eventually no viruses or bacteria (D)	**Level 1 :** 1 mark = 1 comment made about the graph or viral infections 2 marks = 3 comments made about {graph / viral infections} **OR** 1 description and a linked explanation **Level 2 :** 3 marks = 2 descriptions and linked explanations 4 marks = 3 descriptions and linked explanations **Level 3 :** 5 marks = 4 descriptions and linked explanations that includes both virus and bacterial number changes 6 marks = 5 descriptions and linked explanations that includes both virus and bacterial number changes + the cyclical nature of the data	**(6)**

• because viruses destroy bacteria faster than they can reproduce (E)
• viruses have no more host cells / destroyed by macrophages (E)

18- Jan 21

*(b) An investigation was carried out to see if the presence of stripes on cattle reduced the number of biting flies on their bodies.

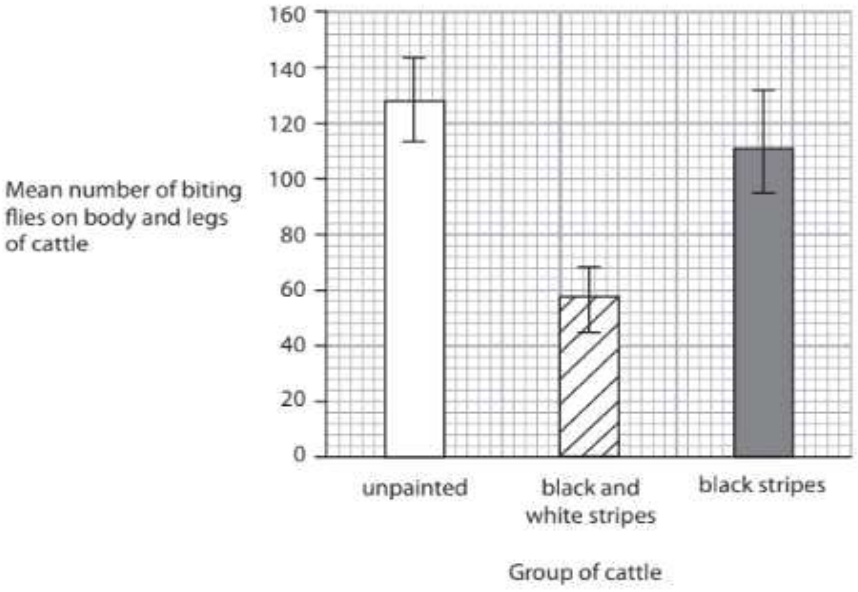
Three groups of black cattle were compared:

- unpainted cattle
- cattle painted with black and white stripes
- cattle painted with black stripes only.

Cattle repel flies by flicking their tails, stamping their feet and skin twitching.

The frequencies of these fly-repelling behaviours were recorded.

The graph and tables show some of the results of this investigation.



Group of cattle	Number of flies on the body	Number of flies on the legs
unpainted	662	1309
black and white stripes	231	710
black stripes	677	1030

Table 1

Group of cattle	Mean frequencies of fly-repelling behaviours / number per hour		
	Flicking their tails	Stamping their feet	Skin twitching
unpainted	54	16	5
black and white stripes	42	10	8
black stripes	55	16	5

Table 2

Determine the effectiveness of painting stripes on cattle in reducing the number of biting flies on them.

Use the information in the graph and both tables to support your answer.

(6)

Question number	Answer	Additional guidance	Mark
*6(b)	Indicative content: **Graph:** • black stripes reduce number of biting flies on body and legs (D) • 128 down to 111 / by 17 / by 13% (D) • this may not be significant as error bars overlap (D) • black and white stripes reduce number of biting flies on body and legs (D) • 128 down to {57/58} / by {70/71} / by 55% (D) • probably significant as error bars do not overlap (D) • black and white stripes reduce the number of biting flies on body and legs more than just black stripes (C) • 111 down to {57/58} / by {53/54} / by {48/49}% (C) • probably significant as error bars do not overlap between the two groups of painted cattle (C) • error bar for black stripes is 17% and 17% for black and white stripes (C) **Table 1:** • black stripes reduce number of biting flies on legs but not on body (D) • 1309 down to 1030 / by 279 / by 21% (D) • black and white stripes reduce number of biting flies on body and legs (D) (body) 662 down to 231 / by 431 / by 65% (D) (legs) 1309 down to 710 / by 599 / by 46% (D) • black and white stripes reduce the number of biting flies on body and legs more than just black stripes (C) • (body) 677 down to 231 / by 446 / by 66% (C) • (legs) 1030 down to 710 / by 320 / by 31% (C) **Table 2:** • black stripes have no effect on {flicking tail / stamping feet / twitching} (D) • black and white stripes have very little effect on {flicking tail / stamping feet} (D) • black and white stripes have small increase on skin twitching (D) • 5 up to 8 / by 3 / by 60% (D)		

19- Jan 21

(b) A quince fruit is made up of cells and contains a lot of juice.

The table shows the composition of carbohydrates in the juice of one species of quince.

Type of carbohydrate	Name of carbohydrate	Concentration of carbohydrate / mg per 100 cm^3 juice
monosaccharide	fructose	817.2
	glucose	308.3
	inositol	8.3
	rhamnose	12.4
	sorbitol	121.1
	xylose	94.0
disaccharide	sucrose	57.0
trisaccharide	raffinose	8.3
tetrasaccharide	stachyose	9.5

Explain the role of decomposition in returning the carbon present in the carbohydrates in the quince fruit back into the atmosphere.

Use the information given in part (b) to support your answer.

General description

- bacteria and fungi are decomposers
- decomposers release enzymes for decomposition
- digested molecules are absorbed into the decomposer
- release carbon dioxide

Details of decomposition of carbohydrates

- carbohydrases are needed to breakdown carbohydrates
- hydrolysis of glycosidic bonds
- to form monosaccharides
- monosaccharides taken up by diffusion
- glucose used in respiration
- carbon dioxide produced by respiration of glucose

Specific detail relating to carbohydrates in the table

- one glycosidic bond broken in disaccharides, two in trisaccharides, three in tetrasaccharides
- using one / two / three water molecules
- e.g. sucrose broken down into glucose and fructose
- monosaccharides do not need breaking down

20-Nov 20

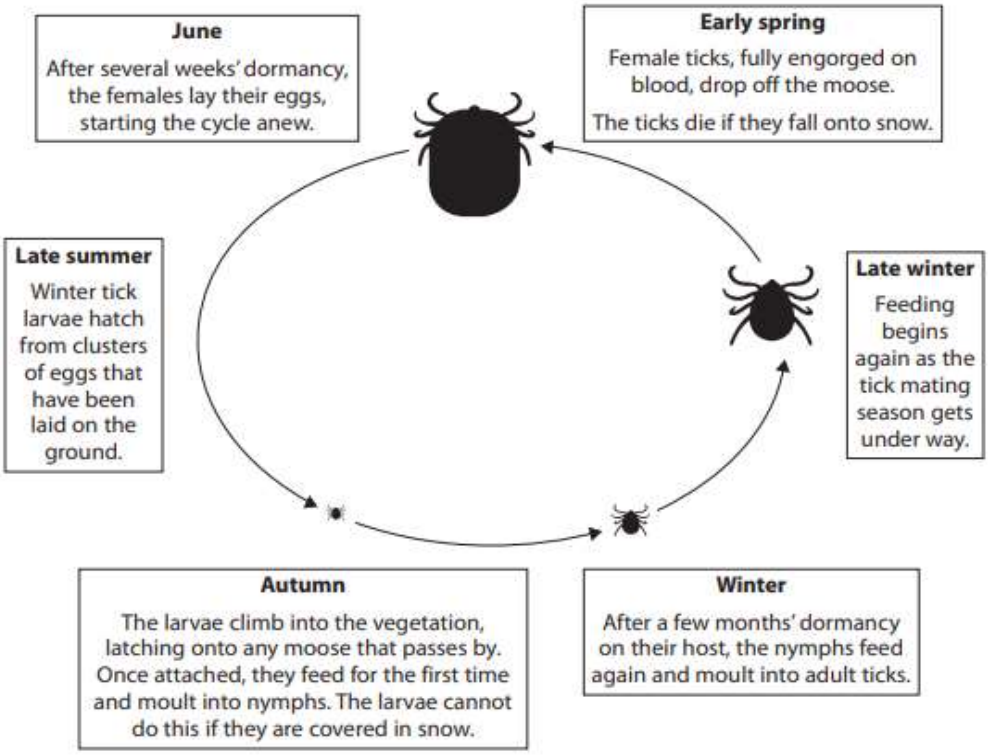
Ticks are parasites that live in the fur of moose.

Ticks are thought to be responsible for the decline in the number of moose.

The table shows the frequency distribution of ticks in a population of moose.

Number of ticks	Number of moose
1 to 9999	32
10000 to 19999	46
20000 to 29999	41
30000 to 39999	32
40000 to 49999	22
50000 to 59999	15
60000 to 69000	9
70000 to 79999	4
80000 to 89999	4
90000 to 99999	3
100000 or more	6

*(ii) The diagram shows the life cycle of the tick.


June
After several weeks' dormancy, the females lay their eggs, starting the cycle anew.
Early spring
Female ticks, fully engorged on blood, drop off the moose.
The ticks die if they fall onto snow.
Late summer
Winter tick larvae hatch from clusters of eggs that have been laid on the ground.
Late winter
Feeding begins again as the tick mating season gets under way.
Autumn
The larvae climb into the vegetation, latching onto any moose that passes by. Once attached, they feed for the first time and moult into nymphs. The larvae cannot do this if they are covered in snow.
Winter
After a few months' dormancy on their host, the nymphs feed again and moult into adult ticks.

The ticks feed on the blood of the moose. One tick can remove 200 to 600 times its body mass.

The ticks irritate the moose. The moose will scratch against trees causing large clumps of fur to fall off.

Explain how global warming might affect the life cycle of ticks and result in the decline in the number of moose.

Use all the information in the question to support your answer.

Question number	Answer	Additional guidance	Mark
*9(b)(ii)	Indicative content: **Comment on global warming (S1)** • global warming will increase the temperature of the earth's {surface / atmosphere} • winters will get warmer so less snow • winters will get shorter so snow present for fewer days **Effect of change on ticks (S2)** • warmer conditions decrease life cycle time • fewer ticks will die in the snow in early spring • more females to lay eggs • larvae less likely to be covered in snow in autumn • so more larvae become nymphs **Effect of ticks on moose (S3)** • more ticks mean larger volumes of blood removed from each moose • moose become weaker if less blood in them • moose die from lack of {nutrients / oxygen / anaemia / energy} (R) • less energy for hunting so they starve (R) • less energy for reproduction (R) • if moose lose their fur they will not be able to keep warm • moose die from the cold (R) • scratching can cause open wounds that can get infected • ticks pass on pathogens • moose die from infections (R)	**Level 1 :** 1 mark = description made from one section 2 marks = descriptions made from at least two sections but no links **Level 2 :** 3 marks = a link made between descriptions of two sections 4 marks = at least two links made between descriptions of all three sections **Level 3 :** 5 marks = links made between all sections with one reason (R) for moose number declining 6 marks = links made between all sections with two reasons (2R) for moose number declining **(6)**	

21-Jan 20

The table shows some of the compounds found in two of these seaweeds.

Compound		*U. fasciata*	*S. linifolium*
*carotenoids	/ mg g^{-1} dry mass	2.00	3.00
*phenols	/ a.u. g^{-1} dry mass	11.95	10.35
*flavonoids	/ a.u. g^{-1} dry mass	7.04	4.53
carbohydrates	/ percentage of dry mass	23.70	25.03
proteins	/ percentage of dry mass	9.56	14.89
lipids	/ percentage of dry mass	2.96	2.16

*(ii) These seaweeds are considered to be a healthy, environmentally-friendly and economic food source.

Comment on this statement.

Use the information in the table and your own knowledge to support your answer.

Question number	Answer	Additional guidance	Mark
*7(b)(ii)	Indicative content: **Healthy** • source of protein – for growth and repair • source of carbohydrate – source of energy • low lipid - reducing risk of heart disease • antioxidants present - reducing risk of heart disease • presence of lipid - risk factor for heart disease **Environmentally-friendly** • sustainable • grows naturally - no need to destroy other habitats / seashore habitats destroyed • photosynthesise - remove carbon dioxide from the atmosphere • do not produce methane like cattle do – less greenhouse gas • vehicles needed to harvest seaweed - produce carbon dioxide **Economic** • seaweed can be grown in situ – no costs planting • do not need fertilisers – no costs buying fertilisers • no buildings needed • no heat needed Level 1 : 1 or 2 relevant points made from at least one aspect Level 2 : 3 or 4 relevant points made from at least two aspects Level 3 : 5 or 6 relevant points from all three aspects which include 1 or 2 justifications		(6)

22- Jan 20

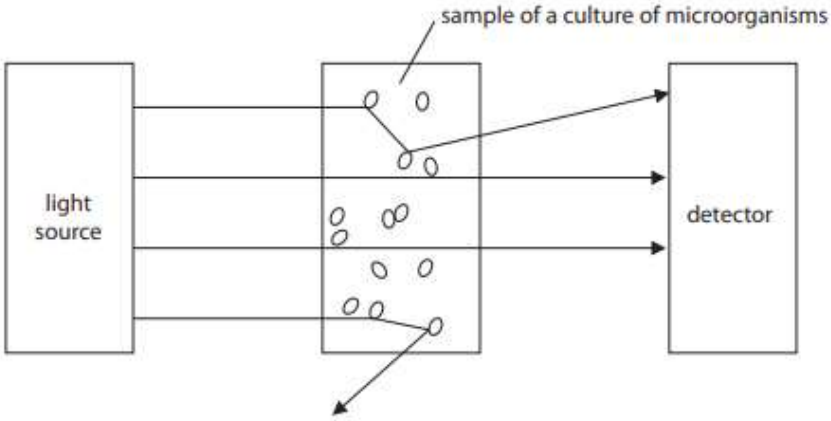
The growth of microorganisms can be studied using optical methods (turbidity).

The number of cells in 1 cm^3 of a culture can be estimated by using a photometer to measure the optical density of the culture.

Light is shone through a sample of the culture and a detector records the optical density.

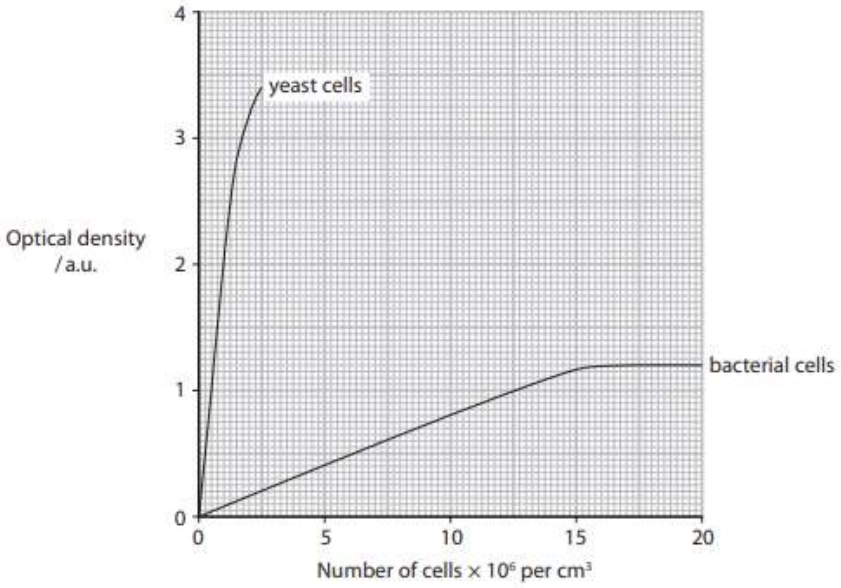
The more light absorbed by the culture, the higher the optical density.

The diagram shows what happens to light shone at a culture of microorganisms.

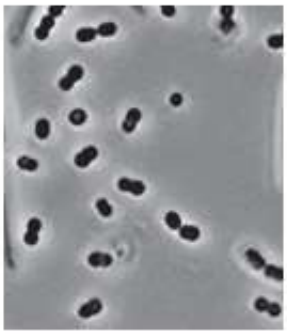


The number of cells in the sample is determined using a calibration curve.

The graph shows a calibration curve for bacterial cells and yeast cells.



The photographs show bacterial cells and yeast cells, as seen using a light microscope.



bacterial cells

yeast cells

scale: 5 µm

*(e) Explain why one calibration curve cannot be used to determine the growth of all microorganisms.

Use all the information in this question and your own knowledge to support your answer.

Question number	Answer	Additional guidance	Mark
*9(e)	Indicative content: • some organisms are larger than others • light more likely to hit a larger organism and be reflected • therefore optical density will be higher • photometers are designed differently • light may have further to travel through the organisms • so is more likely to be reflected back • decreasing optical density • concentration of organisms affects the optical density • so different calibration curves may be necessary for higher concentrations • the light absorbance is specific to the organism • and therefore will affect the absorbance value Level 1 : 1 mark = 1 comment 2 marks = 2 comments Level 2 : 3 marks = 3 comments that includes 1 description / explanation 4 marks = 4 comments that includes 1 description / explanation Level 3 : 5 marks = 5 comments that includes 2 description / explanation 6 marks = 6 comments that includes 2 description / explanation		**(6)**

23-Nov 19

Groups of wolves hunt moose for food.

The photographs below show a wolf and a moose.

© David Osborn / Alamy Stock Photo

© Ron Sanford / Science Photo Library

Magnification ×0.03

*(c) Studies have shown that when salmon is available, wolves will hunt salmon and hunt fewer moose.

The table below shows some nutritional information about meat from salmon and meat from moose.

Nutritional information	Meat from salmon	Meat from moose
energy content / kJ kg^{-1}	6.2	3.9
percentage fat content (%)	8.0	2.5
protein content / g kg^{-1}	255.0	202.0

Explain the advantages for wolves of hunting salmon rather than hunting moose.

Use the information in the table and in the rest of the question to support your answer.

1. idea that salmon are easier to catch as {the moose can run away / salmon are smaller};
2. (hunting salmon) requires less energy;
3. idea that wolf is less likely to get hurt;
4. as the moose have antlers / eq;

4 ACCEPT moose can kick

5. reduced competition between wolves;

5 ACCEPT therefore {more competition / less food to go around}

6. because {hunting for salmon can be done by one wolf / there are a lot of salmon};

6 ACCEPT moose are bigger so wolves need to hunt in packs

7. idea that salmon contain more {energy / fat / protein} (per kg flesh);
8. and therefore, {not so much flesh is needed / wolves can eat less};

24-Jun 19

(b) Environmental DNA (eDNA) is present in seawater at very low concentrations. This DNA is used to study whale sharks.

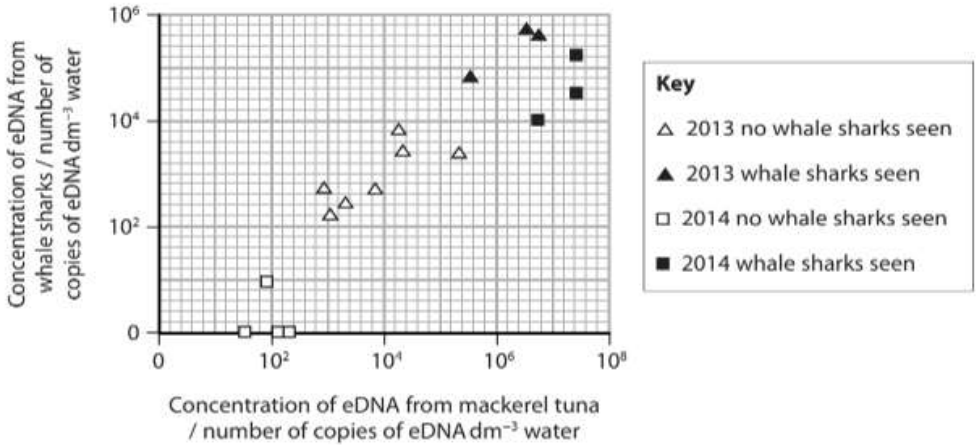
In one study in 2013, scientists determined the concentration of eDNA from whale sharks in the Arabian Gulf.

They also determined the concentration of eDNA from mackerel tuna, a species of fish, in the same area.

The scientists also recorded when they saw the whale shark.

The scientists repeated this study in 2014.

The graph below shows the results of both studies.



*(iii) Describe how the data shown in the graph could have been collected and analysed.

Question Number	Answer	Additional Guidance	Mark
***4(b)(iii)**		**QWC focussing on clarity of account**	
	1. idea of collecting several samples of water ;		
	2. in different areas (of the Arabian Gulf) ;		
	3. idea of recording whether the whale shark was seen or not ;		
	4. idea of extracting the (e)DNA (from the sample) ;		
	5. reference to {**PCR / polymerase chain reaction**} ;	**5 ACCEPT** a description that includes idea of the amplification of (e)DNA	
	6. reference to (gel) **electrophoresis** ;	**6 ACCEPT** a description that includes the idea that (e)DNA is on agar with a current applied	
	7. idea of identifying the {bands / profiles} of (e)DNA as shark or tuna ;		
	8. use known standards of both whale shark and mackerel tuna DNA / eq ;	**N.B.** idea of comparing bands to known bands of whale shark and mackeral tuna = 2 marks	
	9. credit an indication of how the concentration of (e)DNA could be calculated ;		**(6)**

25- Jun 19

6 The membranes of red blood cells contain a number of different antigens. One of these antigens is the rhesus antigen.

People whose red blood cells have the rhesus antigen are rhesus positive (Rh positive).
People whose red blood cells do not have the rhesus antigen are rhesus negative (Rh negative).

The diagram below shows a red blood cell from a Rh positive person and one from a Rh negative person.

red blood cell from a Rh positive person

red blood cell from a Rh negative person

Rhesus disease is a condition where antibodies in the blood of a pregnant woman destroy the red blood cells of her developing baby.

The diagram below shows the sequence of events that lead to rhesus disease.

Step 1
Rh negative mother has a Rh positive baby
Step 2
During the birth of the baby, the blood of the mother becomes contaminated with blood from this baby
Step 3
Rh negative mother has a second Rh positive baby
Step 4
The second baby may be born with rhesus disease

*(ii) Explain why the mother will produce antibodies to the rhesus antigen, in **Step 2**.

Question Number	Answer	Additional Guidance	Mark
***6(b)(ii)**	1. {contaminated blood contains / mother's blood will then contain} rhesus {antigens / red blood cells} ;		
	2. stimulating an {primary / (primary) immune} response (to rhesus antigen) ;	**2 ACCEPT** humoral response / B cell response **IGNORE** cell mediates response	
	3. phagocytes {engulf / eq} the {(red blood) cells / (rhesus) antigens} ;	**3 IGNORE** macrophages	
	4. and become (rhesus) antigen presenting cells (to T helper cells) ;	**4 ACCEPT** rhesus antigen binds to MHC	
	5. activating the {T helper / CD4} cells (to rhesus antigen) / eq ;	**5 ACCEPT** cause {T helper cells to divide / clonal selection / clonal expansion / eq}	
	6. T helper cells release cytokines to activate B cells (to rhesus antigens) / eq;	**6 ACCEPT** cause {B cells to divide / clonal selection / clonal expansion / eq} **IGNORE** T killer cells	
	7. which have (rhesus) antigen attached to them / which are presenting antigen (to themselves) / eq ;	**7 DO NOT ACCEPT** B cells attach to antigen attached to macrophages	
	8. B cells {differentiate / specialise} into plasma cells that produce antibody (to rhesus antigen) ;	**8 DO NOT ACCEPT** B cells produce antibody	**(6)**

26- Jan 19

*(b) Gel electrophoresis can be used to analyse haemoglobin.

Using your knowledge of gel electrophoresis, explain how this technique could be used to analyse haemoglobin in the diagnosis of β thalassaemia.

(6)

Question Number	Answer	Additional Guidance	Mark
***5(b)**	1. idea of (extracting) haemoglobin from {blood / a patient} ; 2. {β subunit / haemoglobin / protein} cut into {fragments / peptides} ; 3. by {(protease) enzymes / proteases} ; 4. reference to {hydrolysis / eq} of peptide bonds ; 5. idea of loading onto gel ; 6. electrical field applied to gel / eq ; 7. idea that the peptides are {stained / made visible} ; 8. idea of comparing the (peptide) bands with bands from a {normal	QWC focusing on clarity **5 NB** this mark point can be applied even if DNA is used in the answer **6 NB** this mark point can be applied even if DNA is used in the answer **7 IGNORE** southern blotting	

27- Jan 19

*(ii) Macrophages are involved in both the non-specific response and the immune response to infection.

Explain the importance of the cell surface membrane of a macrophage in these responses.

(6)

Question Number	Answer	Additional Guidance	Mark
***2(a)(ii)**	1. phagocytosis / {microorganism / eq} is {engulfed by / eq} (the macrophage) ; 2. idea that the {microorganism / eq} is within a {vacuole / vesicle} ; 3. (then) {microorganism / eq } destroyed by the macrophage enzymes / eq ; 4. idea of antigens (of destroyed microorganism) attach to (MHC) molecules on the surface of the macrophage ; 5. for presentation of antigen to T helper cells ; 6. T helper cells become activated / {immune / eq} response initiated / eq ; 7. antibody-binding sites on the surface of the macrophage ; 8. for opsonisation / eq ;	QWC focusing on logical sequence **2 ACCEPT** reference to phagosome **3 DO NOT ACCEPT** virus is killed **5 ACCEPT** macrophages are APC to T helper cells **7 ACCEPT** description e.g. macrophage membrane can attach to antibody	(6)

28- Nov 18

5 Animals are sometimes killed illegally.

Police can use a number of methods to identify the criminal, the specific animal that has been killed and the time of death of the animal.

*(a) In 2000, a tiger was killed in a zoological park for its claws.

In 2005, a tiger claw was found.

Samples of DNA were collected from the claw. The DNA was compared and matched to the DNA of the parents of the tiger killed in 2000.

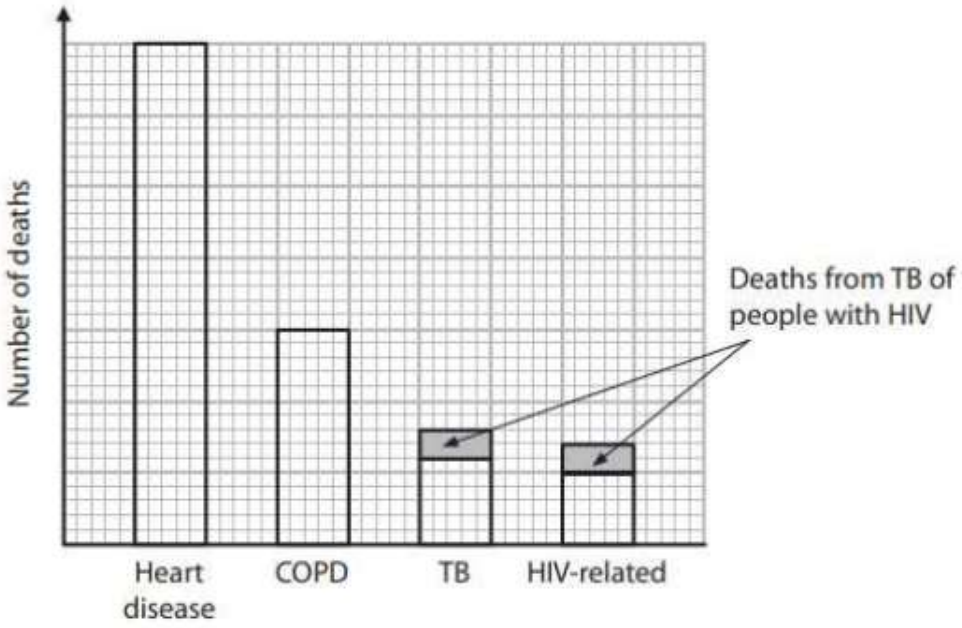
Describe the methods used in this process.

(6)

Question Number	Answer	Additional Guidance	Mark
***5(a)**	1. DNA sample taken from parents using {blood / hair / skin / faeces / claw / eq} ; 2. amplification of the DNA from all three tigers using { PCR / polymerase chain reaction } / eq ; 3. credit details of PCR ; 4. DNA cut into fragments using restriction enzymes / eq ; 5. reference to (gel) **electrophoresis** ; 6. credit details of (gel) electrophoresis ; 7. comparison of the DNA **bands** from the three tigers ;	**QWC emphasis on logical sequence** **1. IGNORE** method of taking DNA from dead tiger **3.** e.g. primers added, different temperatures used for different stages **6.** e.g. electric current applied, use of agarose gel	**(6)**

29- Nov 18

6 The graph below shows the number of deaths caused by some diseases in 2012.



*(c) Explain why death from TB is common in people infected with HIV.

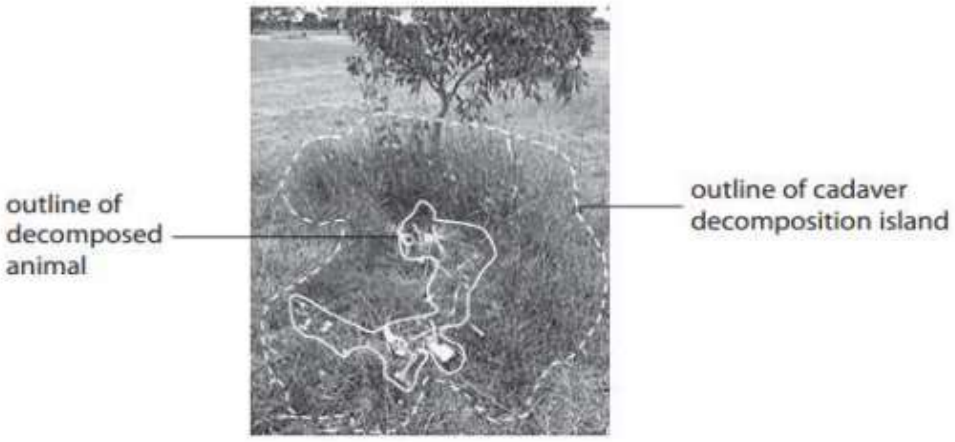
(6)

Question Number	Answer	Additional Guidance	Mark
***6(c)**	1. HIV reduces the activity of the immune system ; 2. because the virus destroys {T helper / CD4 } cells ; 3. idea that TB is resistant to destruction by macrophages ; 4. idea that antigen presentation to T helper cells is impaired (further) ; 5. therefore { B / T killer } cells cannot be activated / eq ; 6. no antibodies (from plasma cells) for {opsonisation / agglutination / eq} ; 7. no {perforins / enzymes / eq} (from T killer cells) to destroy virus-infected cells ; 8. idea that TB is an opportunistic infection ; 9. credit description of how TB results in death ;	**QWC emphasis on clarity of expression** **1. ACCEPT** weakened immune system / reduced T cell count **2. ACCEPT** T killer cells destroy infected T helper cells **3. ACCEPT** macrophages destroyed **4. ACCEPT** T helper cells are not activated **6. DO NOT ACCEPT** kills TB **9.** e.g. high fever, lung damage, organ failure	**(6)**

30- Jun 18

3 When a dead animal (cadaver) decomposes, an area called a cadaver decomposition island can form.

The photograph below shows a cadaver decomposition island.



Magnification ×0.01

*(b) Below are two statements about cadaver decomposition islands.

1. The formation of a cadaver decomposition island is an example of succession.
2. Cadaver decomposition islands increase the biodiversity of an area.

Using the information in the photograph and your own knowledge, explain these two statements.

(6)

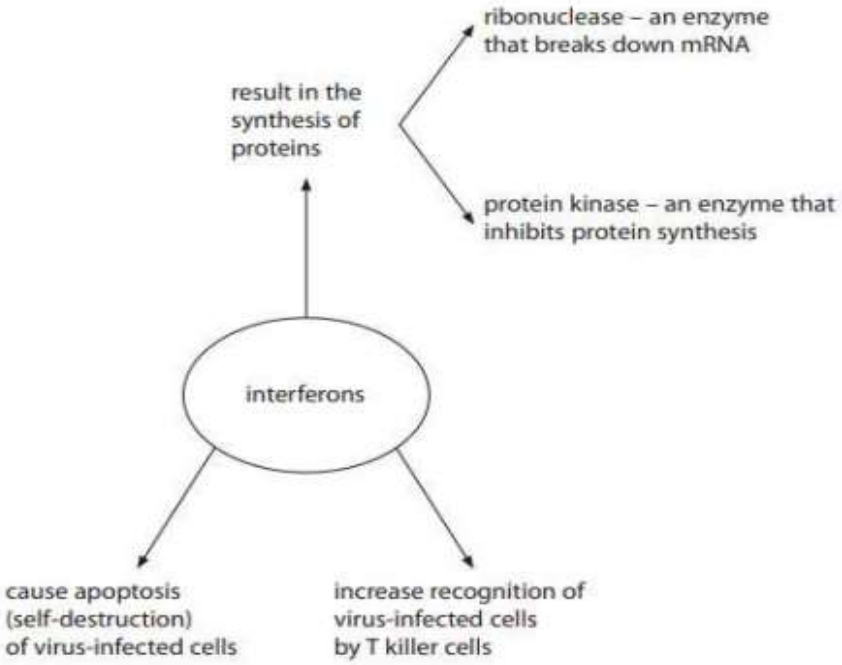
Question Number	Answer	Additional guidance	Mark
***3(b)**	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. idea that decomposition occurs in a sequence of stages ; 2. idea that (during decomposition of animal or new plants) the condition of the soil will improve ; 3. idea that {more / different / longer } grass will start to grow ; 4. followed by trees ; 5. idea of {more / different} animals arriving ; 6. because {food / shelter / habitat} provided ; 7. greater biodiversity because increase in {species richness / (different) species} ;	**QWC emphasis on logical sequence** **1 ACCEPT** a description of some different stages of decomposition **3 IGNORE** references to colonisers / lichens / mosses / bushes / shrubs **4 ACCEPT** a comment about the tree in the photograph **IGNORE** other named larger plants **5 ACCEPT** idea of different insects in the cadaver **6 ACCEPT** the idea that the decomposing animal provides food **7 ACCEPT** increase in different types of {plant / animal / organism}	**(6)**

31-Jun 18

6 Viral infections result in both non-specific responses and immune responses of the body.

(a) Production of interferons is a non-specific response of the body to viral infection.

The diagram below shows some of the effects of interferons.


ribonuclease – an enzyme that breaks down mRNA
result in the synthesis of proteins
protein kinase – an enzyme that inhibits protein synthesis
interferons
cause apoptosis (self-destruction) of virus-infected cells
increase recognition of virus-infected cells by T killer cells

*(i) Using the information in the diagram, explain the role of interferons in viral infections.

(6)

Question Number	Answer	Additional guidance	Mark
*6(a)(i)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. interferons prevent viral replication ; 2. ribonuclease will break down viral RNA (of an RNA virus) ; 3. idea that ribonuclease will break down RNA that has been synthesised (from viral DNA / RNA) ; 4. protein kinase inhibits translation / (breakdown of RNA by) ribonuclease results in no translation ; 5. credit the name of a viral protein that would not be synthesised ; 6. idea that T killer cells will destroy (virus-infected) cells faster ; 7. less time for new virus particles to be produced / eq ; 8. idea that apoptosis releases incomplete virus particles / eq ; 9. idea that these {are engulfed by phagocytes / cannot go onto replicate} ;	**QWC emphasis is clarity of expression** **2 ACCEPT** (viral) mRNA **4 ACCEPT** protein kinase inhibits transcription (of viral DNA) **5** e.g. protein coat / capsid / capsomere / enzyme / named enzyme **6 ACCEPT** more T killer cells to destroy (virus-infected) cells **7 ACCEPT idea that as a result** fewer new cells will get infected **8 ACCEPT** idea that host cell is needed for viral replication	**(6)**

32-Jan 18

4 Global warming is affecting the climate. Changes to the climate are affecting the distribution and development of some animals.

One animal that could be affected by climate change is the Eastern painted turtle.

The photograph below shows an Eastern painted turtle.

Magnification ×0.2

Turtles live in water but lay their eggs on land.

The female turtle comes out of the water, digs a hole in the sand and then lays her eggs in the hole. She then buries her eggs in the sand.

An investigation was carried out into the effect of sand temperature on the rate of development and survival of turtle embryos. The ratio of male to female turtles that hatched was also investigated.

Three temperatures were investigated:

- the optimal sand temperature (OST) for Eastern painted turtles
- a temperature below the OST
- a temperature above the OST.

The table below shows the results of this investigation.

Effect of sand temperature on	**Temperature of sand**		
	Below OST	**OST**	**Above OST**
Rate of development of turtle embryos	Faster than at OST	Fast	Slower than at OST
Proportion of turtle embryos that survive	More survive than at OST	Many survive	Fewer survive than at OST
Ratio of male to female turtles that hatch	More males than females	More females than males	Many more females than males

*(a) Using the information in the table, explain the effect of sand temperature on the rate of development of these turtle embryos.

(6)

Question Number	Answer	Additional guidance	Mark
*4(a)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. as temperature increases the rate of development decreases / eq ; 2. reference to enzymes (involved in development) ; 3. idea that the optimum temperature for these enzymes is below the OST; 4. increase in temperature increases the kinetic energy / eq ; 5. (increase in temperature) increases { number of collisions / energy of collisions / eq } (up to optimum temperature) ; 6. (increase in temperature) results in vibrations of the R groups / eq ; 7. (increase in temperature) causes bonds to break within the enzyme ; 8. denaturing the enzyme / active site does not bind (so well) with substrate / eq ; 9. idea that temperature could be affecting gene activity ;	QWC emphasis on logical sequence **1 ACCEPT** idea that rate of development is faster below OST and is lower above OST **Piece together** **8 DO NOT ACCEPT** start to denature	**(6)**